M I N I S T R Y   O F   T H E   E N V I R O N M E N T

Implementing Quality Management:
A Guide For Ontario's Drinking Water Systems

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Protecting our environment.

Ontario

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Remember, this is only a summary. To be clear about your specific legal requirements, you should refer to the Safe Drinking Water Act, 2002, and the regulations and other instruments made under that Act. For more information, please access the Drinking Water Ontario portal at http://www.ontario.ca/ONT/portal51/drinkingwater or call the Ministry's Public Information Centre at 1-800-565-4923.

A C K N O W L E D G E M E N T S

This guidance document would not exist without the expenditure of a great deal of time and effort from the water sector in the province of Ontario.

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SECTION 1 – PREPARING FOR IMPLEMENTATION

1. Introduction

1.1 Key Points in Chapter 1

- Justice Dennis R. O'Connor, in Part Two of the Report of the Walkerton Inquiry, recommended the adoption of quality management systems for drinking-water systems. It was also recommended that a standard, specifically designed for drinking-water systems, be developed and implemented in Ontario - the Drinking Water Quality Management Standard (DWQMS).

- The adoption of quality management systems is not new to the drinking water community in Ontario; however the requirement to implement the DWQMS is now mandated through the *Safe Drinking Water Act* (SDWA).

1.2 Background

Ontario has established a strong regulatory framework for drinking water systems in the province. This framework under the SDWA and related regulations focuses on compliance-based results which are verified through the Ministry of Environments' compliance and abatement programs.

The DWQMS complements this legislative and regulatory framework by endorsing a proactive and preventative approach to assuring drinking water quality.

Incorporating the concepts of quality management to drinking water systems was recommended by The Honourable Dennis R. O'Connor in Part Two of the Report of the Walkerton Inquiry. In his words:

"The purpose of the quality management approach in the context of drinking water is to protect public health by achieving consistent good practice in managing and operating a water system. The hallmarks of this approach include:

- the adoption of best practices and continual improvement;
- "real time" process control (e.g. the continuous monitoring of turbidity, chlorine residual, and disinfectant contact time) wherever feasible;
- the effective operation of robust multiple barriers to protect public health;
- preventative rather than strictly reactive strategies to identify and manage risks to public health; and
- effective leadership"

This recommendation to adopt a QMS approach has been mandated by the provincial government through the SDWA. To address this requirement in the Act, the Ministry of the Environment has developed, with water industry stakeholders, a quality management standard specific to the needs of the drinking-water systems in Ontario – the DWQMS. The DWQMS is applicable to the owners and operating authorities for all municipal residential drinking-water systems, including treatment, transmission and/or distribution.

1.3 How to Use this Guide

This guidance document has been developed to assist owners and operating authorities in developing, implementing, and maintaining a quality management system for their drinking water systems. The guide has been designed for small and large drinking water systems alike that provide treatment, transmission and/or distribution services. It has been designed to be used by a variety of people including:

- QMS Representatives
- QMS team members
- Management of the operating authority
- Staff at the operating authority
- System owners.

This document contains tips, ideas and suggestions that can help you through the implementation of the QMS. The guidance document is divided into three parts – Part I is the interpretative and implementation guide for the DWQMS; Part II contains sample templates for various procedures; and Part III contains four model operational plans for various drinking water systems.

This guide covers the steps for implementing and maintaining the requirements of the DWQMS, from choosing team members and performing a gap analysis, through to recommendations for maintenance of the QMS.

In addition to this guide and the DWQMS, you should familiarize yourself with other relevant documentation, including but not limited to the following:

- The *Safe Drinking Water Act, 2002, S.O. 2002, c. 32*, as amended
- O. Reg. 170/03, Drinking-Water Systems, as amended
- O. Reg. 188/07, Licensing of Municipal Drinking-Water Systems, as amended
- Director's Directions Minimum Requirements for Operational Plans, July 2007
- Accreditation Protocol: Operating Authorities – Municipal Drinking-Water Systems, July 2007
- Procedure for Disinfection of Drinking Water in Ontario, June 2006.

Review the sample model operational plans provided in Part III and determine which is most similar to your drinking water system. Once you've identified this model plan, review how the various elements of the DWQMS have been documented and then refer to Part I for information on how to implement an element for your specific drinking water system.

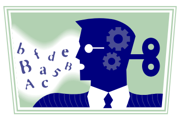
At the start of each chapter in Part I, key points explained in the chapter are summarized and elements of the DWQMS addressed in that chapter are also discussed. At the end of each chapter, a checklist is provided to ensure you complete the main steps before moving on to the next implementation steps.

To assist you, Part II includes sample forms, checklists, policies, and procedures that you can modify for your drinking water system.

Throughout the guide, the following guidance symbols are used in the margins:

Helpful **Tips**

These margin boxes provide helpful hints to aid you in implementation. These hints are based on actual experiences of the pilot-site participants and from other parties involved in preparing this guide.



Technical **Terms**

Technical Terms are defined and explained in the margin, to help explain terms that are being introduced for the first time.

Ready for the **Audit**

What do auditors like to see? These margin boxes provide helpful information in preparing for an accreditation audit. To accredit your operating authority, you will need to achieve a successful audit.

1.4 Definitions and Abbreviations

Accreditation Body – means a person designated or established as an accreditation body under Part IV of the SDWA.

Action Plan – the product of the gap analysis which identifies the tasks for implementing a QMS. The Action Plan should include tasks, target dates, and the people assigned to task duties.

Applicable Legislative And Regulatory Requirements – the *Safe Drinking Water Act*, 2002 the *Ontario Water Resources Act*, 1990 and all regulations and instruments issued under these Acts which are associated with drinking water.

Audit – a systematic and documented verification process that involves objectively obtaining and evaluating documents and processes to determine whether a quality management system conforms to the requirements of the DWQMS.

Authority – official permission or approval to carry out a responsibility or task.

Competence – the combination of observable and measurable knowledge, skills and abilities which are required for a person to carry out assigned responsibilities.

Compliance – the fulfilment of a regulatory requirement.

Conformance – the fulfilment of a DWQMS requirement.

Consumer – the drinking water end user.

Control Measure – includes any processes, physical steps, or other contingencies that have been put in place to prevent or reduce a hazard before it occurs.

Corrective Action – action to eliminate the cause of a detected non-conformity with the QMS, with the requirements of the DWQMS, or other undesirable situations.

Critical Control Limit – the point at which a critical control point response procedure is initiated.

Critical Control Point (CCP) – an essential step or point in the subject system at which control can be applied by the operating authority to prevent or eliminate a drinking-water health hazard or to reduce it to an acceptable level.

Director's Directions – the Director's Directions – Minimum Requirements for Operational Plans issued under subsection 15(1) of the SDWA.

Document – includes a sound recording, video tape, film, photograph, chart, graph, map, plan, survey, book of account, and information recorded or stored by means of any device.

Drinking-Water Health Hazard – means, in respect of a drinking-water system,

a) a condition of the system or a condition associated with the systems' waters, including any thing found in the waters,
   i) that adversely affects, or is likely to adversely affect, the health of the users of the system,
   ii) that deters or hinders, or is likely to deter or hinder, the prevention or suppression of disease, or
   iii) that endangers or is likely to endanger public health,
b) a prescribed condition of the drinking-water system or,
c) a prescribed condition associated with the system's waters or the presence of a prescribed thing in the waters.

Drinking Water Quality Management Standard (DWQMS) – means the quality management standard approved by the Minister in accordance with section 21 of the SDWA.

Drinking-Water System – means a system of works, excluding plumbing, that is established for the purposes of providing users of the system with drinking water and that includes,

a) any thing used for the collection, production, treatment, storage, supply or distribution of water,
b) any thing related to the management of residue from the treatment process or the management of the discharge of a substance into the natural environment from the treatment system, and
c) a well or intake that serves as the source or entry point of raw water supply for the system.

Emergency – a potential situation or service interruption that may result in the loss of the ability to maintain a supply of safe drinking water to consumers.

Emergency response – the effort to mitigate the impact of an emergency on consumers.

Facts – information recorded by the auditor to meet audit objectives, gathered in the course of performing an audit. It includes the results of interviews, document information and observations.

Frequency – the number of times that an audit occurs per unit time, e.g. once a year.

Gap Analysis – the process of determining and evaluating the variance between the requirements of the DWQMS, and the methods and documents in place in your drinking-water system.

Hazard – a source of danger or a property that may cause drinking water to be unsafe for human consumption. The hazard may be biological, chemical, physical or radiological in nature.

Hazardous Event – an incident or situation that can lead to the presence of a hazard.

Implementation Action Plan – the product of a gap analysis which identifies the tasks required for implementing a QMS. The implementation action plan should include tasks, target dates, and people assigned to task duties.

Infrastructure – the set of interconnected structural elements that provide the framework for supporting the operation of the drinking-water system, including buildings, workspace, process equipment, hardware and software, and supporting services, such as transportation or communication.

Ministry – means the Ministry of the Environment.

Monitoring – includes any checks or systems that are available to detect hazards or the potential for hazards.

Municipal Drinking-Water System – means a drinking-water system or part of a drinking-water system,

a) that is owned by a municipality or by a municipal service board established under section 195 of the *Municipal Act, 2001*,
b) that is owned by a corporation established under section 203 of the *Municipal Act, 2001*,
c) from which a municipality obtains or will obtain water under the terms of a contract between the municipality and the owner of the system, or
d) that is in a prescribed class.

Municipal Residential Drinking-Water System – means a large municipal residential system or a small municipal residential system as defined in O. Reg. 170/03.

Non-compliance – a failure under the *Safe Drinking Water Act, 2002*, the *Ontario Water Resources Act*, or any regulations or instruments under these Acts which are associated with drinking water.

Non-conformance – the non-fulfilment of a DWQMS requirement.

Operating Authority – means, in respect of a subject system, the person or entity that is given responsibility by the owner for the operation, management, maintenance or alteration of the subject system

Operational Plan – means, in respect of a subject system, the operational plan required by the Director's Direction.

Operational Subsystem – means a part of a Municipal Residential Drinking-Water System operated by a single operating authority and designated by the owner within operational plans as being an Operational Subsystem.

Owner – includes, in respect of a drinking-water system, every person who is a legal or beneficial owner of all or part of the system, but does not include the Ontario Clean Water Agency or any of its predecessors where the Agency or predecessor is registered on title as the owner of the system.

Preventative Action – action intended to eliminate the cause or causes of potential non-conformance(s).

Primary Disinfection – a process or series of processes intended to remove or inactivate human pathogens such as viruses, bacteria and protozoa in water.

Public – subject system consumers and stakeholders.

Quality Management System (QMS) – a system to:

a) establish policy and objectives, and to achieve those objectives, and
b) direct and control an organization with regard to quality.

Record – a document stating results achieved or providing proof of activities performed.

Rehabilitation – the process of repairing or refurbishing an infrastructure element.

Renewal – the process of replacing the infrastructure element with new elements.

Resources – tangible inputs that are required to deliver safe drinking water.

Responsibility – a charge, trust, or duty for which one is responsible.

Retrievable - For documents, "retrievable" means the documents must be readily available for personnel to refer to, especially in emergency situations, or in areas where operational procedures would need to be promptly referenced. For example, sampling procedures should be available for reference where sampling activities are performed. For records, "retrievable" is a slightly more flexible term. Usually, a record is considered to be retrievable if it can be produced on request by the end of the business day. This definition stems from audits and inspections – if a record can be provided by the end of the audit, it is usually considered to be retrievable.

Risk – the probability of identified hazards causing harm, including the magnitude of that harm or its consequences.

Risk Assessment – an orderly methodology of identifying hazards or hazardous events that may affect the safety of drinking water and evaluating their significance.

Scope – a description of the extent and boundaries of an audit.

Secondary Disinfection – a process or series of processes intended to provide and maintain a disinfectant residual in a drinking-water system's distribution system, and in plumbing connected to the distribution system, for the purposes of:

a) protecting water from microbiological re-contamination,
b) reducing bacterial regrowth,
c) controlling biofilm formation, and
d) serving as an indicator of distribution system integrity.

This process includes the use of disinfectant residuals from primary disinfection to provide and maintain a disinfectant residual in a drinking-water system's distribution system for the purposes described in clauses (a) to (d).

Subject System – means:

a) a Municipal Residential Drinking-Water System where the system is operated by one operating authority, or
b) an operational subsystem where two or more parts of a municipal residential drinking-water system are operated by different operating authorities.

Supplier – an organization or person that provides a product or service that affects drinking water quality.

SDWA – means the *Safe Drinking Water Act, 2002, S.O. 2002, c. 32*, as amended.

Top Management – a person, persons or a group of people at the highest management level within an operating authority that makes decisions about the QMS and makes recommendations to the owner about the subject system or subject systems.

2. About the DWQMS

2.1 Key Points in Chapter 2

- Establishing, maintaining, and continually improving a Quality Management System (QMS) based on the requirements of the Drinking Water Quality Management Standard (DWQMS), is a mandated requirement in Ontario for owners and operating authorities of municipal residential drinking-water systems.
- To obtain a Municipal Drinking Water Licence (MDWL):
    - An operating authority must be accredited by a third party accreditation body for each subject system that it operates,
    - Accreditation will be based on the operating authority having a QMS in place that meets the requirements of the DWQMS,
    - The operating authority will be required to document its QMS in an operational plan which will be endorsed by the owner and submitted to the Ministry for acceptance.
- The DWQMS outlines a framework for planning, documenting and continually improving the management systems in place to support the production and delivery of safe drinking water.
- The operational plan is a living document, and will require an ongoing commitment and endorsement from the system owner and from the personnel throughout the organizational structure of the operating authority.
- The DWQMS builds on concepts that are currently part of the way many owners and operating authorities manage and operate their drinking-water systems.
- The QMS developed for your system will be a continuous cycle of review and improvement – Plan, Do, Check and Improve.

2.2 What is a Quality Management System?

A quality management system (QMS) is a system to a) establish policy and objectives and achieve those objectives, and to b) direct and control an organization with regard to quality.

Management systems and management system standards are not new. They have been around since the early 1950s. In 1987 the International Organization for Standardization (ISO), released the first version of the ISO 9001 Quality Management System Standard. Since that time, organizations all over the world have been implementing the requirements of management system standards.

Most management system standards are generic. They can be applied to any type or size of organization. They have been developed for the implementation of quality- or environmental-based management systems in any type of organization.

Management system standards have also been developed for specific industries or product sectors. For example, there are specific QMS standards for the automotive, medical device and drug industries. The Hazard Analysis and Critical Control Point (HACCP) standard is an internationally recognized, science-based, food safety system that was developed to help ensure the manufacture of safe food products.

The DWQMS is a custom-made standard specific to the requirements of drinking-water systems in Ontario. Its requirements are similar to ISO-based quality management systems, but not equivalent.

2.3 What is the Drinking Water Quality Management Standard?

The DWQMS sets out a framework for the operating authority to develop a QMS that is relevant and appropriate for the drinking-water system; and for the owner to endorse and accept the QMS. The QMS is the foundation for:

- Establishing and documenting management procedures;
- Achieving conformance with the procedures; and
- Demonstrating conformity through an auditing process.

The DWQMS has been developed specifically to address the needs of the municipal residential drinking-water systems in Ontario. The DWQMS contains elements of both the ISO 9001 standard with respect to management systems and the HACCP approach to product safety. Ontario's standard recognizes the current regulatory structure, and the HACCP component has been modified from the traditional food safety methodology to a Risk Assessment approach which reflects the multi-barriers for drinking water safety and the need to continuously supply safe drinking water.

In general, the concepts outlined in the DWQMS concepts are, for the most part, how owners and operating authorities currently manage and operate their drinking-water systems. The DWQMS however, requires that these concepts be formalized and documented in an operational plan, and that there is a documented commitment throughout the organization to continuously review and improve these practices.

The DWQMS approach emphasizes the importance of:

- Proactive/preventative rather than strictly reactive management strategies to identify and manage risks to public health;
- The establishment and documentation of management procedures;
- Meeting these procedures; and
- Continuous improvement of your management system.

The definition of QMS refers to the establishment of policies and objectives. The DWQMS has explicit requirements for policies, but does not make specific reference to objectives. Objectives are, however, embedded or implicit in most of the DWQMS elements.

As noted earlier, the DWQMS applies to all municipal residential drinking-water systems which provide either treatment, transmission and/or distribution services.

2.4 The Municipal Drinking Water Licensing Program

Recommendation 71 in Part Two of Justice Dennis R. O'Connor's Walkerton Inquiry Report stated that the Ministry should move towards a municipal licensing regime incorporating the concepts of quality management. This recommendation forms the basis of the Municipal Drinking Water Licence (MDWL) program.

The MDWL is a new approvals framework for municipal residential drinking-water systems, replacing the current approvals instrument, the Certificate of Approval. Requirements for the issuance of an MDWL, as outlined in subsection 44.1 of the SDWA, are essentially the same as Recommendation 71. The requirements for the issuance of a licence are:

- A drinking water works permit (replacing a Certificate of Approval);
- A permit to take water;
- An approved operational plan;
- An accredited operating authority; and,
- An approved financial plan, if required.

The first two elements of the licence are based on existing Ministry programs. The next two elements of the licence, the operational plan and the accreditation of the operating authority, will be fulfilled through the implementation of the DWQMS. The requirements for a financial plan are currently under development and undergoing public consultation.

2.5 Benefits of Implementing the DWQMS

Management systems are preventative and proactive in nature and focus on continuous improvement. They emphasize a holistic, system-wide approach and attempt to determine the source of problems (root causes) or non-conformances and then make changes to reduce the frequency of occurrence. A robust management system, when effectively implemented, provides a number of benefits to an organization. Some of the benefits of the DWQMS approach are:

- Owners and top management are given tools to continuously assess their systems and to help ensure that Standard of Care provisions are met. The Standard of Care provisions, section 19 of the SDWA, require that those persons who oversee a municipal drinking-water system exercise a level of care, diligence and skill that a reasonably prudent person would be expected to take in a similar situation.
- Accountability for the provision of safe drinking water is shared throughout the entire operating authority as well as with the owner. Through the implementation of the DWQMS, operations staff is given a means to communicate water quality safety issues throughout the organization.
- Management systems create a foundation for improved communication, planning and operational control. During abnormal and emergency conditions, it is essential that documented response procedures are available and that everyone involved is aware of his or her roles and responsibilities to maintain drinking water safety.
- The DWQMS process emphasizes the need to monitor indicators of problems before the problems result in regulatory non-compliance. Appropriate responses and control measures are identified and continuously reviewed.

- The DWQMS recognizes that multi-barriers are necessary to control drinking water quality risks particularly when it comes to microbiological pathogens, and this requires the continual review of the effectiveness of each of these barriers through the risk assessment and management process.
- Through the risk assessment and associated management activities, risks are prioritized and potential control measures are identified to reduce risks and improve water quality safety. This systematic process creates effective decision making, with money and resources spent wisely.
- The documentation of processes and procedures in the operational plan ensures that all personnel have access to the same information and that consistent methodologies are used.
- By adopting a management system approach, operational efficiencies are often identified.
- The implementation of a QMS promotes consumer and owner confidence in the quality of their drinking water.

2.6 What is an Operational Plan?

An operational plan is the documentation of your QMS. **It is not an Operations and Maintenance manual**. The PLAN requirements of the DWQMS identify the policies and procedures that must be documented in the operational plan. If a suitable procedure is already documented in another place, the operational plan can simply reference where that procedure can be found, although the referenced procedure must be available for reviews and audits of the QMS.

If an operating authority is responsible for multiple subject systems, the operating authority may choose to develop common QMS procedures for elements that are common for all drinking-water systems. The common QMS components would need to be implemented both at the subject system level and at the corporate level, and corporate roles, responsibilities and authorities should documented at each level.

The complexity of the QMS will depend to a degree on the size of the drinking-water system and its processes. For small drinking-water systems, which consist of a well with chlorination, the QMS and operational plan can be relatively simple and straightforward. For systems with a number of staff, several connected surface water treatment plants, complex distribution systems, and interconnections to other systems, the quality management system will correspondingly be much larger and more comprehensive. Stand alone distribution systems must also implement the DWQMS.

2.7 Who Must Implement the DWQMS?

The DWQMS requires an operating authority to establish a QMS for each subject system that it operates, and to document the QMS in an operational plan. A subject drinking water system is defined as a municipal residential drinking-water system or its parts that are operated by the operating authority. This means that if a municipal residential drinking-water system has one operating authority for the treatment system and a different operating authority for the distribution system, two separate operational plans would have to be developed.

Although the operating authority is responsible for the development, implementation and maintenance of the QMS at each of its systems, the operational plans become the property of the owner. In this way critical information to support the production of safe drinking water is retained with the drinking water system.

2.8 Who Assumes Responsibility for the DWQMS?

Under the new MDWL program, both the owner and operating authority will have new roles and responsibilities as generally outlined below.

Owner

- Submits application for a municipal drinking water licence, drinking water works permit and permit to take water (unless one is already available and valid).
- Ensures an operational plan is developed and submitted.
- Endorses the contents of the operational plan and submits it to the Ministry for acceptance.
- Is the owner of the operational plan.
- Develops and submits a financial plan (when required).
- Ensures the drinking water system is being operated by an accredited operating authority.
- Monitors the QMS and the need for resources to support the QMS.
- Ensures compliance with the terms and conditions of the municipal drinking water licence and its components.

Operating Authority

- Develops the operational plan in consultation with the owner.
- Effectively implements and maintains the QMS.
- Conducts internal audits and management reviews of the QMS.
- Obtains accreditation from a third-party accreditation body.
- Communicates with the owner about the QMS and resource requirements.
- Ensures compliance with the terms and conditions of the municipal drinking water licence and its components.

The roles and responsibilities for both the owner and operating authority will be further defined by your QMS and documented in your operational plan. Responsibilities for the QMS are shared throughout the organizational structure of the operating authority up to top management, the organizational structure of the owner as well as elected municipal officials.

2.9 Structure of the DWQMS

Implementation of the DWQMS is divided into three steps – PLAN/DO, CHECK and IMPROVE. This structure originates from the Plan-Do-Check-Act methodology seen in some international standards, with the Plan and Do as separate steps. However, the structure of the DWQMS has been modified to better reflect the implementation and maintenance methodology used by the various pilot sites. Even with this change, the steps remain cyclic, so that the quality management system is able to continuously evolve and improve. The steps are explained below.

PLAN/DO – Develop and implement an operational plan, and define and communicate the roles and responsibilities of the owner/operating authority, while defining and carrying out plant and distribution activities and processes to ensure safe drinking water. Within most elements, there are PLAN and DO requirements. The PLAN requirements within typically describe what method or documentation shall be decided upon or prepared, while the DO requirements describe what then must be implemented. The PLAN/DO elements are as follows:

Element 1 – Quality Management System
Element 2 – Quality Management System Policy
Element 3 – Commitment and Endorsement
Element 4 – Quality Management System Representative
Element 5 – Document and Records Control
Element 6 – Drinking-Water System
Element 7 – Risk Assessment
Element 8 – Risk Assessment Outcomes
Element 9 – Organizational Structure, Roles, Responsibilities and Authorities
Element 10 – Competencies
Element 11 – Personnel Coverage
Element 12 – Communications
Element 13 – Essential Supplies and Services
Element 14 – Review and Provision of Infrastructure
Element 15 – Infrastructure Maintenance, Rehabilitation and Renewal
Element 16 – Sampling, Testing and Monitoring
Element 17 – Measurement and Recording Equipment Calibration and Maintenance
Element 18 – Emergency Management

CHECK – Review the effectiveness of the QMS and its implementation by conducting internal audits and management reviews. This provides feedback on the workings of the system.

IMPROVE - Plan and implement a process to use feedback from internal audits and management reviews in order to make improvements to the QMS.

3. Setting Up the QMS Implementation Team

3.1 Key Points in Chapter 3

- The primary resources required for QMS initial development and implementation are staff time and the costs associated with QMS training.
- Training should be made available to the QMS Implementation staff on the DWQMS and its requirements.

3.2 Introduction

The development, implementation, maintenance and continuous improvement of your drinking water quality management system require resources, planning and commitment. It is also important to remember that the QMS is a living system, and that additional resources will be required on an ongoing basis to maintain and improve it.

At the start of implementation, staff should be chosen to assume responsibility for the project. Management will typically be involved at the start of implementation and will assign staff to this role. By involving management at the beginning of the implementation process, you will be able to ensure that the necessary resources are available for your drinking water QMS. Element 3 (d) of the DWQMS requires that top management ensure the availability of the necessary resources for the development, implementation, and continual improvement of the QMS.

3.3 Assign the Implementation Lead

Like any project, your QMS requires an overall managing role, responsible for overseeing the development and implementation of the system. This person is assigned to the role of Implementation Lead.

The ideal Implementation Lead should:

- Be familiar with your drinking-water system.
- Have knowledge of good practices for drinking-water systems.
- Be familiar with the DWQMS.
- Understand the importance of document and record control.
- Communicate the importance of management commitment and endorsement.
- Be aware of audit principles and what will demonstrate that the DWQMS is effectively implemented.
- Be familiar with standard operating procedures.
- Be aware of risk assessment and management principles.
- Be familiar with applicable regulatory requirements.

The Implementation Lead should also have good people and organizational skills, be objective, have good communication skills, and be capable of leading a team. The Implementation Lead does not have to be from management, but it is essential that he or she communicates with management about the QMS during its implementation.

Some of the key tasks for the Implementation Lead include:

- Arranging for staff training and orientation;
- Completing a gap analysis;
- Creating an implementation action plan and keeping it updated;
- Carrying out the implementation tasks or delegating them to others;
- Keeping the QMS implementation on schedule; and
- Reporting progress of the implementation to management.

The role of the Implementation Lead is not defined or required by the DWQMS. However, you will find that many of the roles and responsibilities are similar to those of the QMS Representative, which is an on-going role required by the DWQMS. Depending on your organization, it may make sense for the Implementation Lead to also become the QMS Representative, but this is at your discretion. The person who may be best suited to be a QMS Representative may not be able to devote the time necessary to the implementation role.

3.4 Assign QMS Implementation Team Members

Depending on the size of your drinking-water system and the number of operating authority staff, a QMS team may be necessary for implementation. The QMS team is a group of people who share the responsibilities of implementation. Because the QMS encompasses all areas and aspects of the drinking water system, having staffers on the team with the expertise and knowledge of your current operations and management system is important. As a team, tasks are shared, and can be assigned to individuals best suited to each one.

For the risk assessment task in particular, a team approach that involves people familiar with water systems is necessary. Some systems may benefit by teaming up with neighbouring drinking water systems to complete this task. More detail on the risk assessment activity is provided in Chapter 11 – Risk Assessment and Risk Assessment Outcomes.

The following are some of the tasks that the team may be responsible for:

- Interviews with staff for input on QMS procedures;
- Meetings to brainstorm ideas, methods, and documentation;
- Writing documents; and
- Review and approval of procedures and documents.

The DWQMS and this guidance document have been developed and written to enable implementation by existing staff.

Helpful **Tips**

A good cross-functional team may include:

- An administrative person
- An operator
- A maintenance person
- A management person
- A representative of the owner.

Below are examples of some of the pilot participant teams:

For a drinking water treatment and distribution system servicing approximately 10,000 people in Ontario the implementation team consisted of:

- Implementation Lead – Manager of Operations – Owner/Operating Authority
- QMS Implementation Team Member – Documentation/Process Technician – Owner/Operating Authority

Another pilot participant was a small distribution system servicing approximately 2,500 consumers. The implementation team consisted of:

- Implementation Lead – Public Works Superintendent – Owner/Operating Authority
- QMS Implementation Team Member – Administrative Assistant – Owner/Operating Authority

3.5 Training

Training will likely be needed for all QMS team members. The Implementation Lead will require the most in-depth training, while the necessary training for other team members may be more limited in scope. Arrange for the required training. Methods of achieving training are identified in the box in the margin. Top management members may also require training, depending on their degree of involvement and interest.

In general, training will increase awareness and knowledge of:

- The DWQMS;
- How the DWQMS is implemented, maintained and improved;
- Management systems;
- Auditing principles;
- Resources that may be required;
- Benefits of having a QMS; and
- Responsibilities under the DWQMS.

Acquiring the necessary training for the Implementation Lead, the QMS Team, and top management will make implementation more efficient and your quality management system more effective.

Helpful **Tips**

Training for implementation can be acquired in different ways including:

- Reading this guidance document
- Attending Ministry sponsored DWQMS Implementation Workshops
- Taking courses related to management systems and auditing principles
- Communicating with peers in the industry.

3.6 Communicate New Roles

Ensure that operating authority personnel and management members who are involved in the QMS development and implementation, or who will be affected by it, are aware of their new roles and the responsibilities associated with those roles.

Each implementation team member should be aware of other team member roles. This can done in an announcement, e-mail message, or posting, but is important to show management and staff that the QMS implementation has been initiated, and that it is important.

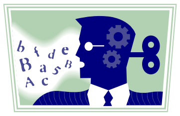
Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
QMS Implementation Lead has been assigned	
QMS implementation team members have been organized, if appropriate	
Training needs have been identified for the QMS Implementation Lead, implementation team members, and management	
Training has been arranged	
Training has been completed	
The new roles of the QMS implementation team have been communicated throughout the organization	

4. Gap Analysis and Implementation Action Plan

4.1 Key Points in Chapter 4

- Performing a gap analysis at this stage will help you estimate the time and resources you will need to implement the QMS.
- The gap analysis is not a requirement of the DWQMS, however it is good practice to undertake it prior to implementing the DWQMS. The gap analysis allows you to build on the systems you already have and identify areas where the DWQMS requirements are not yet being met.
- The gap analysis involves not only reviewing processes and procedures that are documented, but also reviewing existing methods that may not be documented.
- The gap analysis is undertaken by the QMS implementation team and its findings should be discussed with top management and the QMS Representative.



Technical **Terms**

A **Gap Analysis** is the process of determining and evaluating the variance between the requirements of the DWQMS, and the methods and documents in place in your drinking-water system.

- An implementation action plan should be created based on the results of the gap analysis.

4.2 Gap Analysis Overview

In a gap analysis, you compare what you currently have in place with DWQMS requirements, assess where the gaps are, and how to best close these gaps. The results of the gap analysis will help you estimate how much time and what resources you need to implement the QMS. Once this is known, you can develop an implementation action plan and begin to put the missing pieces into place, building as much as possible on what you already have.

A gap analysis requires that you review your existing documents and activities for their conformance with the requirements of the DWQMS. Not all documents need to be reviewed in detail, but you must be aware of what information they contain, and whether each one can be used as is, or be adapted for the QMS.

Helpful **Tips**

Always remember that the purpose of a gap analysis is not to point out what is wrong. Instead, it is to identify areas that need attention, and it is a positive and effective first step in the development and documentation of your QMS.

To perform the gap analysis, a checklist is used, which covers all elements of the DWQMS. A sample checklist template is provided in Part II of this guidance document. The checklist provides tips on where to look for DWQMS elements that may already be in place. The gap analysis is undertaken by the implementation team and other personnel as required.

Observe, ask questions, read documents, and gather information from staff members. All of these notes are recorded on a checklist, and a list of gaps is developed. If there is a team of reviewers, this is done at

a team meeting. Following the gap analysis, meet with key personnel to explain the gaps found, and distribute the completed gap analysis checklist with the gaps clearly identified.

4.3 How to Perform a Gap Analysis

Step 1. Firm up resources. To begin, ensure that top management is in agreement about the purpose of the gap analysis and how much time it will take. A gap analysis performed by one reviewer can take anywhere from one to two days for very small systems to eight to 10 days or longer for larger systems.

You should confirm the availability of the reviewers. The Implementation team usually performs the gap analysis. However other personnel may be required to support the team. Utilizing personnel from other municipalities or a school co-operative education programs, for example, may be an option.

Step 2. Announce the date. Choose a date and notify management and staff. You will need to ask questions, read documents, and tour the facility, which can affect staff schedules, so people must be made aware of what may be involved.

Step 3. Prepare a gap analysis checklist. Use the template provided in Part II or create your own checklist. The template includes ideas of where you may look to find the information that you need. Discuss with reviewers how to use the checklist and what you expect them to do with the checklists once they are complete (file a copy with you, file the original with you, make electronic or hard copies etc.).

Step 4. Refresh your knowledge. Make site visits if you are not familiar with all areas of an extensive system to ensure that you understand what happens and where it happens. Also, review the checklist and any other pertinent resource material.

Step 5. Review documents. Collect documents and using the first column of the checklist, which lists each requirement of the DWQMS, find those requirements in the documents you review. Be objective and open-minded. Here is a sample list of some of the documents you may want to start with (if they exist):

- “As built” drawings
- Process flow schematics
- Equipment manuals
- First Engineer's Reports prepared for the Ministry (assessment of treatment processes, raw and treated water quality, assessment of hazards)
- Official plans
- Hydrogeological studies (capture zones, water quality, assessment of hazards)
- Design reports and briefs: treatment processes
- Optimization studies: water quality, treatment requirements
- Emergency plans, contact lists, and response procedures
- Inspection reports
- Standard operating procedures and work instructions
- Operations and Maintenance manuals
- Plant records
- Maintenance and repair records
- Calibration records

Step 6. Review methods and procedures. In this step, you observe the methods and procedures that are in place that may satisfy the requirements of the DWQMS, even if they are not documented. Using the first column of the checklist, which lists each requirement of the DWQMS, find those requirements in the methods you observe. Observe and listen to information from people when you interview them.

For example, in evaluating Element 6 of the DWQMS, you are looking for a documented description of the subject system and the water source.

Find the requirements in documents to which you have access. The First Engineer's Report, the design brief or report, Certificates of Approval, or Operation and Maintenance manuals for the water system may contain some of the required information. It is always helpful to ask staff for assistance – someone else may know where documents can be found.

Step 7. Record notes. Take notes when you review documents and methods. In the "Notes" column, record details about documents you review, people interviewed, and your observations. These notes document what you observed during your assessment. Record any concerns and comments, especially if you feel a method that is in place is not effective.

Under the "Method in Place?" column, enter a Yes or No if you observed a method in place that meets the requirements of the DWQMS, even if it is not documented. If a method is not required, then enter NA for Not Applicable.

Under the "Documented?" column, enter a Yes or No if the requirement has been documented. If documentation is not required, then enter NA for Not Applicable.

Step 8. Determine gaps. If you reviewed the QMS with a team, discuss your checklist results with other reviewers. The purpose of this step is to go over notes, and decide on areas where gaps exist between the system and the DWQMS requirements.

For each DWQMS requirement, a gap exists when:

- No method or documentation is in place for a requirement.
- A method is in place that satisfies the requirement, but is not documented.
- A method is in place but is not effective.

Record the final decisions about gaps in the "Gap?" column of the checklist. To simplify the review of your completed checklist, highlight the requirements that have gaps associated with them.

Figure 4.1, on the following page, shows an example of one completed section from a gap analysis checklist.

Step 9. Report findings. The gaps now need to be discussed with the implementation team in a closing meeting. If management, operators, and the implementation team are included in this discussion, it will help everyone understand at what point the QMS currently is and what gaps exist.

Requirement	Notes	Method in Place?	Documented?	Gap?
12. Communications				
PLAN – The operational plan shall document a procedure for communications that describes how the relevant aspects of the Quality Management System are communicated between Top Management and:	No documented communication procedure is in place. Existing processes do not address the QMS.	Yes	No	Yes
- the owner,	Top management and owner: - e-mail (between owner and operating authority management) - posting of Council meeting minutes on intranet, internet - communication meetings, where operating authority management can communicate owner activities, decisions	Yes	No	Yes
- operating authority personnel,	Top management and operating authority personnel: - e-mail (between operating authority management and staff) - suggestions box in lunchroom, but not described in procedure.	Yes	No	Yes
- Suppliers, and	Top management and suppliers: currently only the purchasing department communicates with suppliers.	No		Yes
- the public.	Top management and public: through website www.sample.com, and billing stuffers but not described in a procedure.	Yes		Yes
DO – The operating authority shall implement and conform to the procedure.	No formal procedure is in place to be implemented, although some processes are in place. Processes need to be expanded to include the QMS	No		Yes

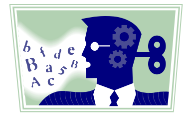
Figure 4.1 Example of a completed section of a gap analysis checklist.

4.4 Create an Implementation Action Plan

With all of the gaps identified, it will now be much easier to start implementation of the QMS. Implementation is more successful using a documented implementation action plan that outlines the tasks, the people responsible for carrying out those tasks, and a realistic time schedule. This should be a document that is uncomplicated to create and edit. A simple table or a spreadsheet is sufficient.

A template for an implementation action plan can be found in Appendix B. The implementation approach in the template matches the steps outlined in this guidance document. Figure 4.2 shows an example with sections of an implementation action plan ready for use. To customize and complete your action plan, here are some tips:

Add dates. Based on the results of the gap analysis and the challenges you anticipate within your system, add a target date for each step. Keep the dates realistic – err on the side of caution and allow more rather than less time – no one can predict the roadblocks you may encounter.



Technical **Terms**

An **Implementation Action Plan** is the product of the gap analysis which identifies the tasks for implementing a QMS. The implementation action plan should include tasks, target dates, and people assigned to task duties.

Add names. Next to each implementation task, add initials or names of the people best suited to complete them. In many cases, especially with smaller municipalities, many or all of the major tasks may be assigned to the Implementation Lead. This is not unusual, however, you should ensure that target dates are realistic based on one person's efforts.

Implementation Step	Tasks	When	Who
Communication	Decide how QMS will be communicated to Suppliers	June 30	BR/RM
	Decide upon any additional QMS communication	July 15	Managers
	Create communications procedure	July 21	BR
	Review and approve procedure	July 21	BR/SS
	Implement procedure	Sept. 30	Managers/All staff

Figure 4.2 Sample section of a completed implementation action plan.

Date and distribute. Date the implementation action plan, and issue it to key personnel, making sure to present it to the people with task responsibilities. The Implementation Lead should keep this implementation action plan updated. As delays or changes occur, review the schedule and make appropriate changes to other tasks that may also be affected by the delay.

4.5 Kick-off Management Meeting

The purpose of the kick-off meeting is to inform and educate everyone on DWQMS requirements and to ensure that everyone is aware of, and in support of, the DWQMS implementation plan.

Normally, the kick-off meeting is held after the gap analysis has been completed and presented, and after the implementation action plan has been created. Here are some key points to know when planning your kick-off meeting:

- For a small to medium size organization, the meeting typically takes several hours.
- The attendees should include top operational management, the implementation team, and other key participants. Board members and elected municipal representatives may also be invited.
- Arrange for someone to take attendance and record minutes.

For systems with a large number of employees, more than one meeting may need to be scheduled.

Use the example below as a guide when establishing the agenda for the kick-off meeting.

1. Introduce everyone
2. Describe purpose of meeting*: "To educate key personnel about the Standard and the implementation process".*
3. Have top management re-state their commitment to the implementation and maintenance of the QMS.
4. Provide a basic overview of DWQMS requirements.
5. Summarize the results of the gap analysis.
6. Verify findings of the gap analysis.
7. Present and explain the proposed implementation action plan, and seek participants to assist with addressing tasks.
8. Confirm participants for key tasks in the implementation action plan.
9. Questions, comments or concerns.
10. Review and close.

Figure 4.3 Sample agenda for a kick-off meeting.

Here are some helpful tips when arranging and carrying out the meeting:

Provide a brief summary of the benefits others have experienced through implementing management systems. Remind everyone of the advantages that can result from implementing management systems.

Use the kick-off meeting to confirm the timeline for the implementation. When you have the key personnel who will be involved in implementation all in one room is an excellent opportunity to review and confirm the overall timeline.

Highlight the positive findings from your gap analysis. Build on the systems you have in place, and take credit for your organization's good practices.

Provide a general description of tasks. Don't get bogged down with discussing the details of each requirement, or "what if" scenarios.

Remind the attendees that the implementation action plan is just that – a plan. It may, from time to time, need to be changed to meet the ongoing needs of the organization.

Be realistic on how much information to provide. This should not be your only meeting with key personnel, therefore tailor the amount of information presented accordingly. Participants will need time to become familiar with QMS concepts, more than one opportunity for learning should be provided.

After the meeting, issue a memo to all attendees thanking them for their participation with a copy of the meeting minutes. Include a revised copy of the implementation action plan if changes were made. Most important of all – make certain that you are prepared to begin implementation the moment the meeting is over.

Helpful **Tips**

Remember to arrange for someone to take attendance and record minutes.

Minutes from the kick-off meeting are one way of showing an auditor evidence of management commitment.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
Preparations for gap analysis	
Document review performed	
Review of methods and activities	
Gap analysis checklist complete	
Gaps identified	
Discussion of gap analysis findings with key personnel	
Creation of implementation action plan with tasks, target dates and assignment of personnel to complete tasks	
Distribution of the implementation action plan to key personnel	
Plan to keep the implementation action plan updated with changes or delays	
Identification of key personnel for the kick-off management meeting	
Preparation of an agenda and scheduling of meeting	
Kick-off management meeting completed	
Minutes of the meeting completed	
Review and update of the implementation action plan	
Confirmation of the timeline for implementation	
Distribution of meeting minutes and revised implementation action plan	

SECTION 2 – IMPLEMENTING THE DWQMS

5. The Quality Management System

5.1 Key Points in Chapter 5

- Defining who is your top management is a crucial step in getting started.

5.2 Translating the DWQMS

What the Standard says…

1. Quality Management System

PLAN – The Operational Plan shall document a Quality Management System that meets the requirements of this Standard.

DO – The Operating Authority shall establish and maintain the Quality Management System in accordance with the requirements of this Standard and the policies and procedures documented in the Operational Plan.

What does it mean?

Element 1 requires that you develop and document a QMS that meets the requirements of the DWQMS. You are about to begin this. The DO requirement requires that you establish and maintain the QMS according to what is written in your operational plan, and according to the requirements of the DWQMS.

The PLAN elements of the Standard outline what must be documented in the operational plan. By completing each of the PLAN sections, you end up with a description of what you have in place for all elements in the Standard. Thus, the majority of your operational plan will be developed.

5.3 Getting Started

Before you begin, it is important to visualize the outcome of the implementation – what your operational plan will look like. It is a good idea to spend some time reading over all the Standard elements prior to beginning, and to start to plan how you will address them, building on the systems, processes and documentation that you already have in place.

The operational plan is a document or series of documents that outlines the processes and procedures for the overall quality management of the drinking-water system. For smaller systems, these may all be contained in one document. For medium and larger-sized systems, the operational plan may be one main document which outlines key points, then refers to other documents, which are located throughout the water system. It is not a requirement that all documents in the operational plan be collated, but they should be thorough, complete, and easy to follow.

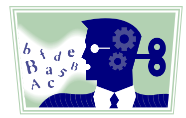
Many organizations have found it most efficient to develop an operational plan shell document which outlines each requirement of the Standard. Where procedures, forms, or other supporting documents are required, the shell document itemizes those documents and notes where they can be found.

Model operational plans are included in Part III of this guidance document. The models are examples of operational plans, based on various types and sizes of drinking-water systems. Use the models to help you visualize what your operational plan may look like. But do not simply change the names in the models and adopt them as your own. What is described in the model operational plans may not suit your drinking-water system. By following this guidance document, using the templates, and following along with the model operational plans, however, you will have the tools required to implement your own QMS, based on the DWQMS requirements.

With the visual concept of an operational plan introduced, there are three key steps in getting your QMS implementation started: identifying top management within your organization; establishing a QMS policy (outlined in Element 2 of the DWQMS); and obtaining Commitment and Endorsement (outlined in Element 3). This chapter describes how to complete the first of these three steps.

5.4 Identify Top Management for Your QMS

Responsibilities for the QMS are shared throughout the organizational structure of the operating authority including the most senior officials. This is necessary, as the quality management approach requires a commitment to seeking and implementing improvements at every level of decision-making, from the policies of corporate management to the day-to-day decisions of those who have ground level responsibility. See Chapter 12 of this guidance document which outlines the requirements for Element 9 of the standard and describes organizational structure, roles, responsibilities and authorities.



Technical Terms

Top Management is a person, persons or a group of people at the highest management level within an operating authority that makes decisions about the QMS and makes recommendations to the owner about the subject system or subject systems.

Part Two of the Report of the Walkerton Inquiry identified the need for all levels of management within an operating authority to understand their responsibilities in the delivery of safe drinking water. For example, contract operating authorities have a level of corporate management, including its Board of Directors and senior management, which are responsible for many different water systems, and corporate management must be capable of managing a large and complex organization in order to ensure the provision of safe drinking water.

The DWQMS definition for top management requires that your top management must be people that meet the following criteria:

- They work within the operating authority,
- They will make decisions about your QMS,
- They will make recommendations to the owner about the subject system or subject systems, and
- They are at the highest level of management within the operating authority making these decisions and recommendations.

Top management does not have to be a single person. The intent is, however, that top management includes all levels of management, including the highest corporate level if appropriate.

Below are several examples of QMS top management structures for various drinking-water systems:

Example 1 – Small Private Operating Authority

A drinking-water system is operated by a private operating authority which is responsible for three small drinking-water systems in Ontario. The operating authority defines top management as the President and Board Members of the operating authority itself. It is defined this way because the Chief Executive Officer (CEO) and Board Members are aware of the specific operations at each of the three drinking-water systems, are intimately involved in making decisions and providing resources for each drinking-water system, and regularly communicate with the owner. Management reviews are carried out by the management of each individual system, and the results of the management reviews are forwarded to top management as well as the owner.

Example 2 – Large Private Operating Authority

A privately operated drinking-water system is operated by a large operating authority, responsible for many drinking-water systems across Ontario. The top management for this QMS is defined as the Chief Executive Officer (CEO) and board members for recommendations regarding the corporate aspects of the QMS. The operating authority system manager for that drinking-water system, and the operating authority area and district managers responsible for that area of Ontario, also have top management roles, as they are responsible for making recommendations to system owners about the drinking-water system. Management reviews are completed by the manager for each drinking-water system. The results of these management reviews, including overall QMS performance and issues, are conveyed to both the district managers and the corporate levels of management in their role as top management, and are also forwarded to the owner.

Helpful **Tips**

Remember to consider the key responsibilities for top management outlined in Element 3, when defining top management.

You can expand your top management to include other key people or groups that you feel may be beneficial to the maintenance of the QMS.

Example 3 – Municipally-operated System

A municipally operated system defines top management as the Water System Manager and Supervisor, as well as the Water Committee Chair. The Water Committee Chair is a member of council who liaises between the staff who are responsible for the operation of the drinking water system (operating authority) and the Mayor and Council (owner). The Water Committee Chair thus represents both the owner and operating authority. Management reviews are performed by top management, with results being presented to the owner (elected municipal officials).

Example 4 – Large Municipal Operating Authority

A municipality is responsible for the operation of eight municipal residential drinking water systems of varying size and complexity. Two levels of top management are defined for each system – corporate and operational. Corporate top management is identified as the Commissioner of Public Works and the Director of Water Supply, as they make recommendations to the owner on each of the drinking water systems, make decisions respecting corporate aspects of the QMS, and review the management review reports for each system. Each system also has an operational level of top management which includes the system manager and supervisor, who perform management reviews for their systems and make decisions on system-specific aspects of the QMS. The owner is kept informed by the Commissioner of Public Works and the Director of Public Works and receives copies of the management review reports.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
Identification of top management	

6. The Quality Management System Policy

6.1 Key Points in Chapter 6

- The next important step is to establish a QMS policy which sets the foundation for the QMS. This policy demonstrates a guarantee by the operating authority that quality management is important.

6.2 Translating the DWQMS

What the Standard says…

2. Quality Management System Policy

PLAN – The Operational Plan shall document a Quality Management System Policy that provides the foundation for the Quality Management System, and:

a) is appropriate for the size and type of the subject system,
b) includes a commitment to the maintenance and continual improvement of the Quality Management System,
c) includes a commitment to the consumer to provide safe drinking water,
d) includes a commitment to comply with applicable legislation and regulations, and
e) is in a form that provides for ready communication to all Operating Authority personnel, the Owner and the public.

DO – The Operating Authority shall establish and maintain a Quality Management System that is consistent with the Policy.

What does it mean?

Element 2 of the DWQMS requires the development of a QMS policy. A policy is the driver for the quality management system – firm documented commitments to demonstrate the operating authority's assurance that quality management is important. The PLAN component outlines three main commitments that must be in the policy: to maintain and continually improve the QMS, to comply with applicable legislation and regulations, and to provide safe drinking water to the consumer. In this manner, the organization's commitment to drinking water quality is documented. The PLAN component of this element also requires that the policy be in a form that can be easily communicated. The DO component requires that the operating authority ensures that the QMS is consistent with the commitments made in the QMS policy.

6.3 Preparing the QMS Policy

The QMS policy is the backbone of the quality management system. This is an important step that should be performed with input from top management.

Use the checklist in Figure 6.1 to create the minimum statements required in your QMS policy.

Larger organizations in particular may choose to make commitments that go beyond the minimum requirements of the Standard. These additional pledges could include such things as commitments to:

- Implement and/or maintain other management systems such as an environmental management system (ISO 14001).

- Be an active participant in industry associations.
- Be involved in research and development.
- Introduce new technologies as appropriate.
- Promote energy and resource conservation.

CHECKLIST	
Requirement	**Complete?**
Create a statement that describes your commitment to, at a minimum, comply with applicable legislation and regulations.	
Create a statement that states your commitment to maintain and continually improve the QMS.	
Create a statement that states your commitment to the consumer to provide safe drinking water.	
Review the policy, and ensure that the commitments made are appropriate to the size and type of the subject system.	
Ensure the policy is in a form that will be easy to communicate. You will need to communicate the policy to operating authority personnel, the owner, and the public. Think of what it will look like when communicated, and how you will do that.	

Figure 6.1 Checklist of minimum statements required in the QMS policy.

Although not necessary to meet the requirements of the DWQMS, these additional pledges may increase consumer confidence, advance the drinking water industry, improve drinking water safety and quality, reduce certain liabilities, or reduce operational costs and environmental impact.

Keep in mind that if additional commitments are made in the policy statement, the external auditor will seek proof that they are being met. As these additional commitments are not a required part of the DWQMS, they do not have to be documented in the operational plan; however some organizations may choose to do so.

Figure 6.2 shows an example of a QMS policy created under the DWQMS for a large treatment system, operated and maintained by an independent operating authority. Figure 6.3 shows an example of a QMS policy created under the DWQMS for a small well supply and distribution system, owned and operated by the municipality.

Policy commitments are for everyone with responsibilities related to the drinking-water system. Encourage management to be involved in creating the policy, not just in approving it after it is written. Top management input during policy creation not only enhances its value, but also shows commitment. The policy must be supported by top management and the owner, through an endorsement of the operational plan. It is the cornerstone of the system.

QMS POLICY FOR LAKE ONTARIO WATER SUPPLY SYSTEM

The ABC Board utilizes the services of Water Inc., an independent contract operating authority, to operate and maintain the water supply system. Together, the ABC Board and Water Inc. are committed to:

- Managing and operating the Lake Ontario Water Supply System in a responsible manner in accordance with documented quality management system policies and procedures.
- Providing the consumer with clean, safe drinking water.
- Promoting owner and consumer confidence in the safety of the drinking water supply.
- At a minimum, meeting all applicable legislative and other requirements, and encouraging our suppliers and subcontractors to similarly meet these requirements.
- *Promoting resource stewardship, including conservation.*[1]
- *Being a quality leader in the business sector in which we participate.*[1]

The ABC Board and Water Inc. strives to accomplish its goals through the dedication, support and participation of all employees, and the maintenance and continual improvement of the Quality Management System.

ABC Board of Management - Owner ***Water Inc. – Operating Authority***
June 1, 2006
[1] these are additional commitments beyond the requirements of the DWQMS.

Figure 6.2 Sample QMS policy for a large treatment system.

QMS POLICY FOR THE WESTHILL WATER SUPPLY AND DISTRIBUTION SYSTEM

The Municipality of the Town of Westhill owns, maintains and operates the Westhill Water Supply and Distribution System.

The Town of Westhill is committed to:

1. ensuring a consistent supply of safe, high quality drinking water,
2. maintaining and continuously improving its quality management system, and
3. meeting or surpassing applicable regulations and legislation.

The Muncipality of the Town of Westhill
June 1, 2006

Figure 6.3 Sample QMS policy for a well supply and distribution system.

6.4 Approve the QMS Policy

After creating the policy, give the draft policy to top management for review and approval. Once approved, the policy does not stay the same indefinitely – it will be continually reviewed and approved. The purpose of the review is to ensure the QMS policy is current and appropriate for the QMS and the drinking-water system. Chapter 24 of this guidance document discusses in more detail the QMS activities you will perform once your QMS is in place. However, at this stage, you should decide the frequency and methodology for top management to regularly review the QMS policy.

6.5 Add the QMS Policy

The QMS policy must be documented in the operational plan. Ensure this documentation is complete. Although not required in the DWQMS, it is helpful to describe in the operational plan, how the policy statement was developed, how it will be reviewed by top management, and how often this review will occur. This will ensure that QMS policy development, review and approval are always performed consistently.

6.6 QMS Consistent with QMS Policy

The DO component of Element 2 requires that the operating authority establish and maintain a QMS that is consistent with the QMS policy. This means the commitments you make in the QMS policy must be an integral part of your QMS.

You should be able to demonstrate, with documentation, that your QMS is consistent with the QMS policy – especially the commitments.

For example, the sample policy in Figure 6.3 has three key commitments. Documentation to support commitment #1 may include consideration of the Annual Report prepared for the MOE under O. Reg. 170/03. To demonstrate commitment #2, the operating authority may refer to all QMS documents showing updates and revisions (revisions indicate that a document was reviewed, edited, and subsequently improved), or the results of management reviews and internal audits and subsequent actions (see Chapters 19 and 20).

A crucial part of ensuring the QMS is consistent with the QMS policy is communicating the QMS policy to operating authority personnel. This is discussed further in Chapter 14 – Communications.

Ready for the **Audit**

What do auditors like to see for QMS policy?

- A QMS policy that is appropriate for the size and type of the subject system or subject systems.
- The required commitments in the policy
- A policy that is available in a form to allow for ready communication.
- That the policy is part of the operational plan.
- That staff, especially management, are able to discuss how the QMS is consistent with the QMS policy and how the commitments are being met.

When interviewing personnel about any topic, throughout the entire audit, auditors will assess policy understanding and awareness. They may ask interviewees: "What does the QMS policy mean to you?" or "Explain what you think the QMS policy means?"

Remember that during both internal and/or external audits, top management is expected to demonstrate conformance to the QMS policy. Your data should support the statements contained in your policy.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
Creation of the QMS policy	
Have all the points on the checklist for creating the QMS policy been addressed?	
Approval of the QMS policy	
Addition of the QMS policy to the operational plan	

7. Obtaining Commitment and Endorsement

7.1 Key Points in Chapter 7

- Obtaining top management commitment to the QMS is crucial to its successful implementation.

7.2 Translating the DWQMS

3.	**Commitment and Endorsement** PLAN – The Operational Plan shall contain a written endorsement of its contents by Top Management and the Owner. DO – Top Management shall provide evidence of its commitment to an effective Quality Management System by: a) ensuring that a Quality Management System is in place that meets the requirements of this Standard, b) ensuring that the Operating Authority is aware of all applicable legislative and regulatory requirements, c) communicating the Quality Management System according to the procedure for communications, and d) determining, obtaining or providing the resources needed to maintain and continually improve the Quality Management System.
What does it mean? This is a critical element to put into place early on in the implementation. The PLAN component of Element 3 requires that the operational plan is endorsed, in writing by top management and the owner. The DO component of Element 3 requires that top management is able to **prove** its commitment to the QMS. Top management must be involved in the QMS, and provide direction and resources. This involvement must be demonstrated by awareness and in the QMS documentation. There are broad responsibilities for top management outlined in the DO component of Element 3. Documents and records that will be created as a result of implementing the QMS will help provide proof of management commitment.	

7.3 How to Obtain Top Management Commitment

Top management commitment is a crucial part of a successful QMS implementation. Without the authority, direction and support of top management, it would be very difficult to plan the implementation and to create a QMS. The QMS must be adopted as an integral part of your organization and necessary resources must be provided, starting now and into the future. The lack of top management commitment can be a major reason for the failure of management systems.

Obtaining or establishing top management commitment is both an initial and ongoing activity. Here are some steps that can help you obtain top management commitment.

Inform and Include Top Management

During implementation, your Implementation Lead should be responsible for ensuring that top management is updated about the progress of the implementation through regular meetings, reports, or

other methods as appropriate. All levels of management should be aware of the Standard and this guidance document.

By including the Implementation Lead in the planning, and having the Implementation Lead communicate with top management, top management will understand what is needed to get the job done and the requirements for ongoing maintenance of the DWQMS. By being informed about the actual implementation, top management learns the requirements of the Standard and fulfills those requirements for which it is responsible.

Without real management commitment, the DWQMS will only be a paper exercise that will prove to be very difficult to implement, awkward to maintain and impossible to improve - and will not add any value to the operation of the drinking-water system. If it is not important to top management, why should it be important to anybody else?

Proving Management Commitment

The DO component of Element 3 of the DWQMS requires that top management be able to prove its commitment to the development, implementation and continual improvement of the QMS. This proof will be created as you continue to follow this guidance document, and implement your QMS.

If you are in top management and you want to demonstrate commitment:

- Become engaged in the implementation process (you do not have to manage or lead it, but overseeing it is a positive contribution).
- Read, understand and participate in the completion of those requirements of the Standard that are intended for top management.
- Ask about the progress of the implementation as part of running the drinking-water system. Be proactive, you do not have to wait for a scheduled meeting to get a quick verbal update.

7.4 Resources

The DO component of Element 3 requires that top management determine, obtain or provide the resources needed to maintain and continually improve the QMS. For this requirement, obtain means the procurement of resources within the operating authority's responsibility and/or purchasing authority. For resource procurement beyond this authority, "obtain" shall be interpreted to mean a duty to provide reasonable notification to the owner of the identified needs, along with some assessment of the risks of not providing the resources, and possible options where feasible. Obtain implies that the owner must be aware of the operating authority's needs and the possible consequences of not meeting them. This is critical for the operating authority, particularly where it does do not have full authority.

Ready for the **Audit**

What do auditors like to see for management commitment?

Expect the auditor to interview a sample of personnel in top management.

The auditor will ask questions about how the QMS has performed, how it is communicated, and how and why top management is involved in the QMS.

The auditor will be investigating top management's awareness of the QMS and how it is integrated with other operations.

The auditor will look for participation of top management in the management review process by interviewing and reviewing documents. Participation may include discussion of topics and initiated action items.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
Management commitment obtained	

8. The QMS Representative

8.1 Key Points in Chapter 8

- A QMS Representative must be appointed. The QMS Representative may be the same person who is your Implementation Lead or he or she can be someone else within your organization.

8.2 Translating the DWQMS

What the Standard says…

4. Quality Management System Representative

PLAN – The Operational Plan shall identify a Quality Management System representative.

DO – Top Management shall appoint and authorize a Quality Management System representative who, irrespective of other responsibilities, shall:

a) administer the Quality Management System by ensuring that processes and procedures needed for the Quality Management System are established and maintained,
b) report to Top Management on the performance of the Quality Management System and any need for improvement,
c) ensure that current versions of documents required by the Quality Management System are being used at all times,
d) ensure that personnel are aware of all applicable legislative and regulatory requirements that pertain to their duties for the operation of the subject system, and
e) promote awareness of the Quality Management System throughout the Operating Authority.

What does it mean?

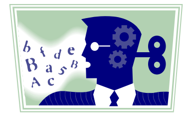
Element 4 describes specific requirements for a special role in the QMS – the QMS Representative - who is appointed by top management. Element 4 requires that the operational plan identifies a QMS Representative. The responsibilities and authorities for that specific role are prescribed in parts a) to e) of the DO component. The QMS Representative is generally responsible for the QMS, and channels important QMS information to top management. The QMS Representative may be, but is not required to be, from system management or top management.

8.3 About the QMS Representative Role

The QMS Representative, who is appointed by top management, performs a key role in the QMS. The individual chosen for this role may be the Implementation Lead identified earlier in this guidance document; however, he or she can be someone independent of the Implementation process. This role focuses on the QMS once it is implemented. This is an ongoing role and relates to the ongoing maintenance of the QMS during your first QMS cycle, the accreditation of the operating authority, and beyond.

Top management should appoint the QMS Representative and circulate a written memo about the appointment. It is important that top management choose a person with the ability and authority to be responsible for the QMS, and to communicate QMS issues clearly and promptly. The QMS Representative should have sufficient authority to ensure that the needed processes are established, implemented and maintained throughout the organization, and to report directly to top management on performance and any needed improvement. In the written notice, top management confirms that it appoints and authorizes the QMS Representative.

The QMS Representative must be aware of his or her responsibilities. Ensure that the QMS Representative has reviewed with top management the responsibilities listed in Element 4, and is comfortable with them. Of course, the QMS Representative does not have to carry out all the tasks necessary, but is responsible for ensuring that those tasks are complete. The prescribed responsibilities are:



Technical **Terms**

Responsibility is a charge, trust, or duty, for which you are responsible. To be responsible means to be correspondent or answerable, accountable to another for something.

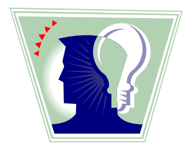
Authority is official permission or approval to carry out a responsibility or task.

a) **Ensuring that processes and procedures needed for the QMS are established and maintained.** This means that the QMS Representative is responsible for the QMS being established and maintained. If resources are required, or other issues arise, it is the responsibility of the QMS Representative to address those needs by reporting on and discussing them with top management.

b) **Reporting to top management on the performance of the QMS and any need for improvement.** It is not acceptable for a QMS to fail because top management was not aware of the need for improvement. The QMS Representative is responsible for ensuring effective communication of these issues.

c) **Ensuring that current versions of documents required by the QMS are being used at all times.** Ultimately, it is the QMS Representative who is responsible for document control.

d) **Ensuring that personnel are aware of all applicable legislative and regulatory requirements that pertain to their duties in the operation of the subject system(s)**. Ultimately, it is the QMS Representative who is responsible for ensuring that personnel are aware of their legislative and regulatory responsibilities.



Helpful **Tips**

The **QMS Representative** role can be filled by more than one person. For large, complex systems, one QMS Representative alone may not have sufficient time or skills to fulfill all of the QMS Representative's responsibilities.

e) Promoting awareness of the QMS throughout the operating authority. Spreading information about the QMS throughout the operating authority is the ultimate responsibility of the QMS Representative.

8.4 Choosing the QMS Representative

The QMS Representative should:

- Be familiar with your drinking-water system.
- Have knowledge of best practices for drinking-water systems.
- Be familiar with the DWQMS.
- Understand the importance of management commitment.
- Be familiar with audit principles and what is needed to demonstrate that DWQMS requirements have been met to an auditor.
- Be familiar with applicable legislative and regulatory requirements.
- Have good, open communication with top management

Ready for the **Audit**

Expect the auditor to interview the QMS Representative.

The auditor will want to see that the QMS Representative fully understands his or her responsibilities, and that the authority to carry out those responsibilities has been provided.

The auditor may also want the QMS Representative to prove that those responsibilities have been met. For example, to show an auditor that the performance of the QMS has been reported to top management, the QMS Representative may be asked to show meeting minutes or e-mail messages.

The auditor will also review the operational plan to ensure the QMS Representative is documented there. The auditor may also review other documentation to verify that the QMS Representative has been made aware of his or her responsibilities.

The auditor may also ask for documents to demonstrate that top management appointed and authorized the QMS Representative.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
Appointment of a QMS Representative	
Authorization of the QMS Representative to carry out the listed responsibilities	
Identification of the QMS Representative in the operational plan	

9. Document and Records Control

9.1 Key Points In Chapter 9

- You must write down what you do to ensure that procedures are in place to provide safe drinking water.
- Clear, consistent documents are crucial to the effectiveness of a drinking water QMS.
- Current versions of operational documents must be available to those who need them, when they need them.
- Records must be available as proof of the effectiveness of the QMS, and your water system's operation.
- Documents and records must be controlled to ensure that personnel have the most up-to-date information available.

9.2 Quiz: Test your understanding of Document and Record Control

Try this quiz now, and then again after you have finished reading this chapter.

Answer TRUE or FALSE	TRUE	FALSE
1. Records should be kept forever, but documents should not.		
2. We can go back and change a record if we have to.		
3. It is a good idea *not* to leave blanks when filling out a form.		
4. We need a procedure that describes how we control records and documents.		

Answers

1. **False** – The length of time that you retain records or documents depends on legislation, standards, and internal company policies and preferences.

2. **False** – Records cannot be changed. They are static results or data that provide objective evidence that a specific action was performed.

3. **True** – Even if there is no information to fill in, you should enter a reason why, such as NA for Not Applicable, or NR for Not Required. Without this, when the record is reviewed at a later date, an auditor may think the form was not complete.

4. **True** – The DWQMS requires that you describe your document and record control methods in a written procedure.

9.3 Translating the DWQMS

What the Standard says…

5. Document and Records Control

PLAN – The Operational Plan shall document a procedure for document and records control that describes how:

a) documents required by the Quality Management System are:
   i. kept current, legible and readily identifiable
   ii. retrievable
   iii. stored, protected, retained and disposed of, and
b) records required by the Quality Management System are:
   iv. kept legible, and readily identifiable
   v. retrievable
   vi. stored, protected, retained and disposed of.

DO – The Operating Authority shall implement and conform to the procedure for document and records control and shall ensure that the Quality Management System documentation for the subject system includes:

a) the Operational Plan and its associated policies and procedures,
b) documents and records determined by the Operating Authority as being needed to ensure the effective planning, operation and control of its operations, and
c) the results of internal and external audits and management reviews.

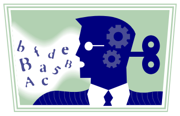
What does it mean?

Element 5 requires that you establish a process to manage and control the documents and records needed by the QMS, and that you need a procedure to describe this process. A document and records control process is necessary to ensure that documents are kept up-to-date with changes in your operations and changes in applicable legislation and regulations, that documents and records are legible, and can be easily located and identified. The procedure must also describe how documents and records are stored (so that they are protected from damage or loss), define record retention times, and methods for disposal afterwards.

The DO component of this Element requires that you follow the procedure. It also details what documentation constitutes the documented QMS. The creation and management of these documents and records are implicitly covered by following the Procedure.

9.4 Why Do I Need to Control Documents and Records?

The establishment and maintenance of an effective document and records control system is the foundation of any quality management system.



Technical **Terms**

Document – includes a sound recording, video tape, film, photograph, chart, graph, map, plan, survey, book of account and information recorded or stored by means of any device.

Record – a document stating results achieved or providing proof of activities performed.

Helpful **Tips**

Everyone will need to read and use QMS documents. Because documents need to change as the system evolves, you must teach all personnel to always:

- Check that the version of the document that they are using is the most current.
- Communicate changes that affect your drinking-water system to the appropriate personnel, so QMS updates can be made.

Controlling your documents and records will:

- Develop and protect the knowledge base of your QMS.
- Facilitate training of new personnel.
- Ensure consistent procedures are followed.
- Ensure the most up-to-date versions of documents are easily retrievable.
- Provide accountability.
- Facilitate review and audit by auditors.
- Facilitate inspections.
- Establish due diligence.
- Promote owner and consumer confidence.
- Facilitate internal and external communications.
- Ensure that decisions are based on current, and accurate information.

Document and records control is a key element in assisting the operating authority to deliver safe drinking water. For example, without document and records control, if you have a large staff, or recent staff turnover, it may be difficult to ensure procedures are consistently followed by everyone. In urgent situations it may not always be possible to quickly retrieve a necessary record or document. Your document and records control will help you to manage these situations.

9.5 Documents and Records Explained

Documents provide the foundation of the QMS. They include the QMS policy, the operational plan and related procedures, instructions, manuals, records, forms, and some communications, in paper or electronic form. Documents can be internal, or can come from external sources, such as legislation or permits. Regardless of its source, if a document is part of the quality management system for your drinking-water system, it must be controlled.

Records are proof of activities performed, or results achieved, and refer to events that happened in the past. A quality record provides evidence that quality requirements have been fulfilled, and can show the effectiveness of the operation of a QMS element. A record can be written or stored on any data medium. Records must also be controlled.

Remember: Documents can be changed; records cannot be changed.

The best document control system is usually the simplest one that can be easily brought into the existing system. The sophistication of the system varies with the size and complexity of the operation. Build on what you already have in place – record retention is already required for your drinking-water system under O. Reg. 170/03 and O. Reg. 128/04. For these records, you merely need to document what you already do to meet DWQMS requirements.

9.6 Which Documents and Records are Included?

Begin by assessing the types of documents and records within your drinking-water system that may be included in the scope of your QMS.

Internal QMS Documents include the operational plan, your QMS policy, and other policies, procedures, instructions, and program requirements.

External QMS Documents include legislation and regulations directly applicable to your drinking-water system, the DWQMS, legal permits and licences. These documents are not controlled by you, but may be changed by external parties. Your responsibility under the DWQMS is to ensure that your versions of all QMS documents, internal or external, are up-to date; that revised/updated documents are reviewed to see if there are any implications for your drinking-water system; and that changes that affect your drinking-water system are communicated to appropriate staff.

QMS Records include test results, completed forms and checklists, reports, and meeting minutes. Although they cannot be edited or updated like other documents, they still require control in terms of storage and accessibility.

Some examples of documents and records are shown in Figure 9.1.

EXAMPLES		
Internal QMS Documents	**External QMS Documents**	**QMS Records**
Operational Plan	Legislation and Regulations	External laboratory test results
Policies	Permits	In-house laboratory test results
QMS Procedures	Licences and Certificates	Completed operator log books
Work Instructions	The DWQMS	Completed checklists
Standard Operating Procedures	Industry Standards	Raw water quality records
Blank Forms and Checklists		Monitoring records
		Training records
		Meeting minutes

Figure 9.1 Examples of documents and records that should be within the scope of your QMS.

9.7 Retrievable Documents and Records

Information must be available to be useful. The DWQMS requires that documents and records are retrievable; however this means different things for documents or records.

For documents, retrievable means that the documents must be readily available to personnel, especially in emergency situations, or in areas where operational procedures need to be promptly referenced. For example, sampling procedures should be available for reference where sampling activities are performed.

For records, retrievable is a slightly more flexible term. Usually, a record is considered to be retrievable if it can be produced on request by the end of the business day. This definition stems from audits – if a record can be provided by the end of an audit, it is usually considered to be retrievable.

Note that for document retrieval, personnel may only view documents, not change them. Only people authorized to make changes to documents should have that capability, especially for electronic documents. Using read-only formats for electronic documents and using password protection for master copies are two methods of protecting electronic documents.

Answer the questions in Figure 9.2 for your drinking-water system. Be sure to interview personnel and test document access in remote locations or challenging situations before answering.

Answer YES or NO	YES	NO
Can all personnel find the documents and records they need?		
Can they access them easily and right away?		
Can they still access them in off-hours?		
Can they still access them in an emergency, during a hydro outage for example?		
Are documents available where they are needed?		
Can changes to documents only be made by authorized personnel?		

Figure 9.2 Questions about documents and records control for your system.

If you have answered No to any of the questions, you need to make changes in the availability of documents and records.

9.8 Keeping Documents Current

As processes and activities change within the drinking-water system, the operational plan, its policies and procedures and other documents may need to be updated. Element 5 requires that QMS documents be kept current.

Designate a staff member to be responsible for making document edits in a timely manner as changes occur, and ensure the person has access to the master QMS documents. Depending on the complexity of your drinking-water system, more than one staff member may be assigned to this duty. The document editor you choose should be someone who is aware of changes as, or even before, they occur.

In addition to reviewing documents as changes occur, at least once a year, a team of reviewers should be scheduled to check **all** QMS documents, to ensure that the information is still correct and current. This review activity is recorded on the QMS Schedule, found in Appendix N.

9.9 Making Documents Consistent

It is important that the QMS be flexible. However, creating some basic requirements for how documents and records look and what information they display will make it easier for personnel and auditors. Here are some useful documentation guidelines:

Use unique, simple and clear titles. Keep titles simple but informative. For titles of forms, choose titles that match the originating procedure, so they are easily found. Numbering documents is a very effective way of managing, locating, and retrieving documents.

Number pages. Number each page, including the total number of pages in the document (e.g. Page 1 of 4)

Show revision dates. For documents, make sure a date of revision is visible to instantly indicate when the document was last updated. Adding a revision date to the header or footer ensures visibility of key information on each page. A list or table of all revision dates should also be included in the document to prove the document is being reviewed and revised. For records, ensure that a date is always recorded with data.

Establish a consistent format. Decide on the preferred format for headers, footers, logos, subtitles, and font. This makes QMS documents easily recognizable, and also simplifies the creation of new documents. An example of a document format is shown in Figure 9.3.

Helpful **Tips**

Some ways to make sure your QMS document editor stays aware of upcoming system changes:

- Invite the editor to planning meetings where system changes may be discussed.
- Create a reminder checklist that prompts the editor to stay aware of changes, and gives direction about what QMS updates may be required as a result.
- Add a monthly reminder to the editor's calendar to review changes with managers.
- Ensure the editor receives copies of municipal council meeting minutes, where appropriate.

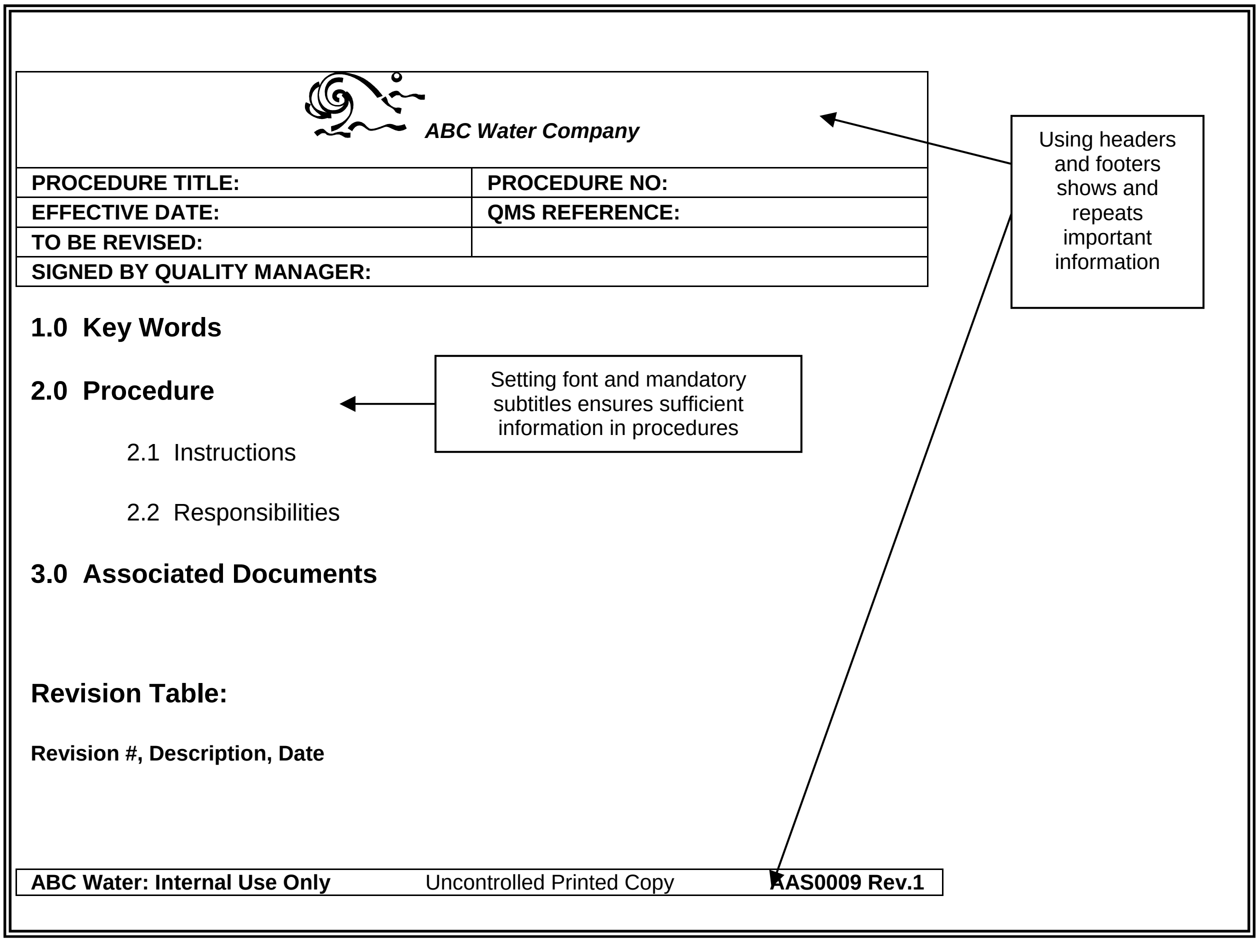


Figure 9.3 An example of a procedure format based on a format preferred by one of the pilot drinking water supply systems.

9.10 Issuing Documents

Before any QMS document is used, it should be reviewed and approved. Without this step, errors can occur, methods can be inconsistent, and a considerable risk to drinking water can arise. Reviewers are responsible for:

- Ensuring that documents are technically correct, complete, and up-to-date.
- Determining that the information is practical, and makes sense.
- Ensuring that application of the document will be effective and efficient.
- Approving the document if it meets these criteria.

Select appropriate reviewers for the different types of QMS documents. Also, establish a method for approval that will easily prove that a document was reviewed and approved. This can be achieved with digital or written signatures, or confirmation e-mail messages, for example.

As changes occur, documents will need to be updated, as described in Section 9.8. It is crucial to ensure that personnel are aware of the changes, revised documents are available, and obsolete documents are not used. When documents are available only in digital form, this is easily done. However, when paper

copies of documents are in circulation, be aware of the printed copy locations, so that the printed copies may be immediately and easily replaced. The Table you will create in Section 9.13 will assist in managing document locations.

9.11 Protecting Documents and Records

Documents and records can be stored in digital or paper format, both of which have unique protection challenges. Damage or loss may come from humidity, water, fire, accidental deletion, misfiling, dust, theft, accidental disposal, or physical damage. Digital records should be backed up to protect them from loss or damage. Paper records should be stored safely and protected.

Examples of digital records may include:

- E-mail messages
- Digital laboratory test results
- SCADA files
- Data spreadsheets
- Maintenance work orders.

If you archive documents, the DWQMS requires that archived documents are protected and available. Archiving documents is usually done to free up filing space, and to thin out bulky files. Ensure archived documents are easily retrieved and available by:

- Keeping archive areas neat and organized
- Clearly labelling archive boxes, binders and files
- Choosing an archive area away from everyday traffic.

Ready for the **Audit**

What do auditors like to see?

- Typed or neatly printed records.
- Pens used to record data, not pencils.
- No blanks left on forms.
- Documents found easily and quickly.
- Organized file-keeping.
- Dates and titles on all documents.
- Proof that documents are kept up-to-date.

9.12 Retaining and Disposing of Documents and Records

Documents and records must have designated minimum retention times, which must comply with applicable legislated requirements, and conform to the DWQMS. Once established, documents and records must be filed according to designated storage times. Some storage times are legislated, while other storage times may be set by the municipality, parent company, or other management bodies. Minimum requirements for drinking water-related record retention times are listed in Figure 9.4.

Record	Retention Time	Legislation
Operator training records	5 years	O. Reg. 128/04 under *SDWA, 2002*
Annual Reports and Summary Reports prepared by the owner	5 years	O. Reg. 170/03 under *SDWA, 2002*
Log books and other record-keeping mechanisms	5 years	O. Reg. 128/04 under *SDWA, 2002*
Lab analyses of water samples for chemical tests	15 years	O. Reg. 170/03 under *SDWA, 2002*
Lab analyses of water samples for microbiological, chlorine and turbidity tests, and fluoride tests where fluoridation is provided	5 years	O. Reg. 170/03 under *SDWA, 2002*

Figure 9.4 Related legislated minimum retention times.

You must also decide what to do with documents and records after the storage time has expired. Shredding and recycling are common methods for disposal, or you may choose to retain documents and records indefinitely and maintain archival records. You should be able to prove your awareness of the minimum time regulations according to legislation or other sources, even if you choose to retain documents and records indefinitely.

9.13 Optional Document and Record Control Table

To help control documents and records, you can create a Document and Record Control Table, although this is not a requirement of the DWQMS. The table can be an effective means of satisfying DWQMS document and records control requirements, and will simplify document updates, since you can see all of the document and record control requirements at a glance. For larger systems, separate tables for documents and records may be more effective.

A template for the Document and Record Control Table can be found in Appendix C. A sample section of the Document and Record Control Table can be seen in Figure 9.5.

Document and Record Control Table								**NR = not required**
Date of Revision:	*June 1, 2006*	**Document Requirements**				**Record Requirements**		
Document or Record?	**Type of Document**	**File Location (of master)**	**Location of Printed Documents**	**Authorized Editor**	**Reviewers / Approvers**	**File Location**	**Retention Time**	**Disposal Method**
R	*External Lab Test Results*	*NR*	*NR*	*NR*	*NR*	*control room*	*15 years*	*shred*
R	*Training Records*	*NR*	*NR*	*NR*	*NR*	*QMS Manager, personnel files*	*indefinitely*	*not applicable*
D	*Emergency Response Manual*	*o:/QMS/emerg*	*control room, QMS office, front lobby, loading dock*	*H&S Committee*	*Senior Managers*	*NR*	*NR*	*NR*
D	*Operational Plan*	*o:/QMS/plan*	*control room, QMS office*	*QMS Manager*	*Senior Managers, Council*	*NR*	*NR*	*NR*
D	*Printed Legislation*	*web bookmark QMS office*	*QMS office*	*not applicable*	*QMS Manager*	*NR*	*NR*	*NR*

Figure 9.5 Example of a document and record control table.

Complete the document and record control table for your drinking-water system. Be sure to consider all types of QMS documents and records within your drinking-water system.

9.14 Control Procedure and Operational Plan

The DWQMS requires that your operational plan includes a documented procedure to describe document and records control for your drinking-water system. Depending on the complexity of your drinking-water system, you can have separate procedures for document control and record control, to better organize your requirements.

Using the new format established in Section 9.9, create a Document and Record Control Procedure, or separate procedures, including a link to the Document and Record Control Table. In addition to the information in the table, you will need to describe:

- How documents and records are retrievable
- How documents are kept current
- Your requirements for format and legibility
- The method for review and approval
- How documents and records are protected and stored.

If you choose not to use a Document and Record Control Table, you will need to cover all of the requirements listed in the PLAN component in Element 5 directly in your procedure.

A sample Document and Record Control Procedure can be found in Appendix P. The sophistication of the procedure you create will vary with the size, complexity, and culture of your drinking-water system. Figures 9.6 and 9.7 show an example of a completed Record Control Procedure. Because the drinking-water system in this example is complex, the document control would be covered in a separate procedure.

Helpful **Tips**

For writing a procedure:

- Start by jotting down what is important.
- If the instructions are short, list the steps one by one.
- If the instructions are long or more complex, group the steps.
- If the user of the procedure must make decisions, use a flow chart.
- Remember to keep sentences short and precise.

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IF APPROPRIATE

Title: Control of Records	Control I.D. Pro 2	Rev: Draft Date: 9/Feb/06
Author:	Reviewer:	Approver:

1.0 Purpose

The purpose of this procedure is to describe the methods for identification, storage, protection, retrieval, retention time and disposition of records.

2.0 Scope

This procedure is applicable to water department employees who manage or perform work related to the water plant and distribution operations. This procedure covers all QMS records identified in the implemented DWQMS.

3.0 References

DWQMS Element 5
Ontario Regulation 128/04
Ontario Regulation 170/03
SDWA, 2002 Section 17, Clause (2)

4.0 Definitions

Soft Copy – a record that is generated or retained in electronic format.
Current Record – a record that has not yet exceeded its specified minimum retention time.

5.0 Procedure

5.1 Records are maintained as objective evidence that the requirements of the applicable legislation and regulations and the DWQMS have been effectively met.
5.2 Records may be retained in hard copy (i.e. test reports, lab results, equipment maintenance and calibration etc.) or in soft copy (i.e. SCADA, Excel etc.).

Records Required by MOE Regulations
5.3 All records required by the MOE regulations (referenced above) to demonstrate compliance and/or conformance shall be maintained according to the regulations
5.4 Record retention
5.4.1 Minimum retention times for all MOE required records are as follows:

Five Years

Test Records:
- Schedules 6, 7, 8, 10, 23 and 24 of O. Reg. 170/03
- Schedule 3 of O. Reg. 169/03

Training Records:
- Certification of Operators – O. Reg. 128/04

Reports:
- Annual Reports, Section 11 of O.Reg. 170/03
- Summary Reports for Municipalities, Schedule 22 of O. Reg. 170/03

Figure 9.6 Sample of a completed record control procedure.

5.4.2 All other records where a minimum retention time is not specified by the applicable regulation. This includes records required by the DWQMS.

Fifteen Years

Test Records:

- Schedule 13 and17, (Sections 17-10 through 17-13) of O. Reg. 170/03

Reports:

- Schedule 21 of O. Reg. 170/03
- First Engineer's Report

5.4.3 All records required to demonstrate conformance to the requirements of the DWQMS shall be retained for the following minimum time periods:

Five Years:

- Corrective Action Requests
- Preventative Action Requests
- Internal QMS Audit Reports
- Management Review Minutes
- Calibration Results
- Consumer Enquiries (Relating to Drinking Water Quality)
- Service Requests
- Water Committee Minutes
- Supplier Evaluations

5.5 All logs, records and reports that demonstrate compliance and/or conformance shall be retained/filed chronologically [O. Reg. 128/04 27 (2)] by type and in such a manner as to make them accessible. Additionally, data/information entered into all logs, records and reports shall clearly identify the individual responsible for making the entry.

5.6 All records and reports that demonstrate compliance and/or conformance shall be stored in a manner that protects them from damage or deterioration. Care shall be taken to ensure that no records, hard or soft copy, are exposed to elements or conditions that may damage the integrity of the information contained therein.

5.7 All records generated by the SCADA system may be retained in either hard or soft copy per the retention times indicated in section 5.4.

5.8 Records that have exceeded the minimum retention times prescribed by regulation or this procedure shall be disposed of in a manner appropriate to the nature of the information contained therein. Any records that are retained for knowledge, legal or other purposes beyond the specified minimum retention time shall be stored separately from those records that are deemed to be current. Where required by regulation, records shall be made available to the public upon request.

5.9 All records shall be readily retrievable for the purposes of the utility owner or for inspection by a regulatory body.

6.0 Associated Forms/Procedures/Work Instructions

7.0 Records

8.0 Change History

Rev. Level	Date	Change	By

Figure 9.7 Sample of a completed record control procedure (continued).

When you have completed this procedure, arrange for its review and approval.

9.15 Implementing the Procedure

From this point forward, when creating, filing, archiving, and disposing of QMS documents and records, personnel must follow the requirements that you have established.

With document and records control firmly established, personnel must be made aware of the requirements. Later, in Chapter 21 – Completing the QMS Cycle, the task of training personnel in QMS concepts and new requirements will be discussed. However, key personnel who are assisting with implementation must be made aware of applicable document and record control requirements now. This can be done informally, simply by discussing the new procedure with them.

The final task is completing the relevant section of your operational plan. Element 5 requires a documented procedure, so add your Document and Records Control Procedure to the operational plan.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
Completed the Quiz to test your understanding of document and records control	
Documents and records are retrievable	
Documents can only be edited by authorized personnel	
A method is in place to keep documents current	
A consistent format for documents and records has been established	
All the Ready for the Audit points in this chapter's margins are in place	
A method is in place for reviewing and approving documents	
A method is in place for issuing updated documents and removing obsolete ones	
Documents and records are protected	
Retention times for records have been determined	
Disposal methods for records have been determined	
The Document and Record Control Table is complete	
The Document and Records Control Procedure is written and approved	
The Document and Records Control Procedure has been added to the operational plan	

10. Drinking-Water System

10.1 Key Points in Chapter 10

- In this chapter, a description of your drinking-water system should be developed that provides readers with a thorough understanding of your drinking-water system.

- The concept of effective multiple barriers is a cornerstone in the production and delivery of safe drinking water.

10.2 Introduction

The purpose of the tasks outlined in Chapters 10 and 11 is to ensure processes and procedures are in place to assess the current capability of a water provider's management and operating system for providing safe drinking water, to identify areas where improvement is needed, and to implement these improvements.

The key features of this approach to assessing risks include:

- Practising prevention rather than reaction,
- Distinguishing greater risks from lesser ones,
- Reviewing results and performance to learn from experience, and
- Investing resources in risk assessment that are proportional to the risk posed.

With the DWQMS, responsibility for risk assessment activities is given to the operating authority and operational staff with the most comprehensive knowledge of the drinking-water system. You will find that many elements necessary to prevent, control and mitigate hazards are already in place, and that procedures need only be documented to satisfy the requirements of the DWQMS.

The risk assessment approach as laid out in the next two chapters will lead to:

- An assessment of the multiple barriers;
- The identification of activities and processes considered essential for the control of water quality (critical control points) where in the event of a breakdown water safety could be threatened; and
- The establishment of mechanisms to provide operational control at critical points, including methods that will monitor performance and trigger response measures where required.

10.3 The Multi-Barrier Approach

The best way to achieve a healthy public water supply is to put in place multiple barriers that keep water contaminants from reaching people. An overview of the multi-barrier approach follows.

The multi-barrier approach is an integrated system of procedures, processes and tools that collectively prevent or reduce the contamination of drinking water from source to consumer in order to reduce risks to public health. The multiple barriers include the three main components of the drinking-water system: source water, water treatment and water distribution. The management and monitoring systems for the three main drinking-water system components are equally important.

The management systems should ensure the development of well-planned, thorough and practised responses to adverse situations, including specific responses to the loss of control and for emergency situations. These are required when other processes fail or there are indicators of deteriorating water quality. The multiple barriers include:

- **Source protection** to keep the raw water as clean as possible in order to lower the risk that hazards are present.
- **Treatment** to remove and/or neutralize hazards.
- Maintenance of the integrity of the **distribution system** to prevent recontamination after treatment.
- **Monitoring programs** including on-line monitoring to detect system problems which could impair drinking water safety, and to verify the performance of the system components and finished drinking water quality.
- Effective **management** systems including automatic control systems, well-developed responses, and operating practices are the ultimate means for protecting the safety of drinking-water systems.

Source water protection issues will be managed primarily through the Source Water Protection Committees to be established under the Clean Water Act. Emergency Preparedness and Response will be addressed under Element 18 of the DWQMS (Chapter 18). Through the risk assessment process, treatment and distribution system barriers will be assessed as they apply to your drinking-water system. The monitoring, control and management systems to ensure drinking water quality and safety will be documented, assessed and improved. Figure 10.1 provides an indication of how the multi-barrier approach could be applied for a surface water treatment system.

Hazard	Barrier	Typical Risk Management Approach
Pathogens Chemical contaminants Radionuclides	Source	Source Water Protection Plan Upstream sewage treatment Choice of water source
Pathogens	Treatment	Water quality standards Chemically assisted filtration Disinfection
Infiltration – introduction of pathogens and chemical contaminates Pathogen regrowth	Distribution system	Chlorine residual System pressure Capital maintenance plan
Undetected system failures	Monitoring	On-line monitoring Alarms and shut-offs as appropriate Logbooks, trend analyses
Failure to act promptly when control limits are not met Failure to communicate promptly with health authorities and the public	Management Systems	Response measures Communication procedures

Figure 10.1 Example of the multi-barrier approach (adapted from Part Two of the Report of the Walkerton Inquiry).

The purpose of the First Engineer's Report for your drinking-water system was to assess the potential for microbiological contamination and mitigate this potential, and to identify operational and physical improvements necessary to mitigate contamination using the multiple barrier concept. This task builds on the system assessment process initiated with the First Engineer's Report.

10.4 Translating the DWQMS

What the standard says…

6. Drinking-Water System

PLAN – The Operational Plan shall document, as applicable:

a) for the subject system:
   i. a description of the system including all treatment processes and distribution system components
   ii. the name of the Owner and Operating Authority
   iii. a process flow chart
   iv. a description of the water source, including:
      i. general characteristics of the raw water supply
      ii. common event-driven fluctuations and
      iii. any resulting operational challenges and threats
   v. a description of any critical upstream or downstream processes relied upon to ensure the provision of safe drinking water.

b) if the subject system is an operational subsystem, a summary description of the municipal residential drinking-water system it is a part of.

c) if the subject system is connected to one or more other drinking-water systems owned by different owners, a summary description of those systems which:
   i. indicates whether the subject system obtains water from or supplies water to those systems, and
   ii. names the Owner and Operating Authority of those systems

DO – The Operating Authority shall ensure that the description of the drinking-water system is kept current.

What does it mean?

The purpose of Element 6 of the DWQMS is to provide a broad overview and foster a basic understanding of your drinking-water system and its water source. The outcome of this task is a process description and flow chart. Your drinking water system should be described including key treatment processes such as primary and secondary disinfection. Major components of your distribution system should also be described.

The name of the owner and operating authority should be documented. If part of a larger drinking water system, the larger system must be described and the owner and operating authority should also be named. Although not required by the DWQMS, a general description of both the owner and operating authority, and the relationship between the two, can be useful and very informative.

The water source should be identified and described. This description may possibly be obtained from your First Engineer's Report. The water source should be characterized in terms of both general characteristics of the raw water supply, and common event-driven fluctuations due to changes of seasons, storms, spring run-off, algae blooms, lake turnover, etc. Key operational challenges and threats should also be identified.

You must also show important processes beyond the system boundaries upon which you rely. For example, if your system consists of a distribution system only, a critical upstream process relied upon is the supply of safe drinking water and the operation of the upstream water treatment plant.

Finally, the DO component of Element 6 requires that you keep all of this information current.

10.5 What Level of Detail is Required?

A great deal of detail is not required. The Process Flow Diagrams (PFD) and the Process and Instrumentation Diagrams (P&ID) required for the review of applications for Certificates of Approval, for example, are often more detailed than are needed. These drawings typically provide more information than is required, can be difficult to understand, and can make it hard to distinguish key process elements from less important ones. Critical information on the processes and systems to ensure drinking water safety should be presented in an accessible manner.

The QMS process flow chart should be easy to understand and should provide a broad overview of the drinking-water system, and the components that are critical for maintaining process performance.

10.6 What Steps are Involved?

Begin by compiling and reviewing background information to help you through the following steps:

- Describe the drinking-water system.
- Construct a process flow chart of the drinking-water system.
- Identify and describe the water source, including general characteristics, common event-driven fluctuations, and operational challenges.
- Describe the upstream or downstream processes upon which you rely.
- Describe the larger drinking-water system of which you are a part, if applicable
- Prepare a section to include in the operational plan.

10.7 Description of the Drinking-Water System

The description of your drinking-water system provides background information for the risk assessment to be completed in the next chapter. It establishes a common information base for assessing the risks with the production and delivery of safe drinking water (Elements 7 and 8 of the DWQMS).

The information in this section will provide the basis for making effective decisions about managing risks. Documentation is required to allow the information to be easily accessed and reviewed.

Begin by generally describing the drinking-water system. Figure 10.2 suggests what information to include.

Helpful **Tips**

The information required for this element of the Standard should be already available to your team in your drinking-water system documentation (review your Annual Report, Engineer's Reports, and Inspection Reports, for example).

Reviewing and inserting into the report what you already have will involve less effort than creating it.

Treatment process schematics, water system maps, and watershed maps can assist in preparing the overview.

When preparing the description of your drinking-water system, use language that your employees will understand. This is **your** drinking water QMS.

You can use schematics, flow charts, tables and/or graphical tools when describing your system. Pictorial representations are often more readily understood.

Component	Details
Subject system ownership	Name
Subject system operating authority	Name
Subject system description	If your system includes treatment, describe all treatment processes If your system includes distribution, describe names or numbers of reservoirs, pressure zones, booster pumping stations, number of customers, size of infrastructure etc. Keep it simple.
Water source description	Include general characteristics of the raw water supply, any common event-driven fluctuations and any resulting operational challenges and threats
Critical upstream processes used	Describe
Critical downstream processes used	Describe
Connected system ownership	Name
Connected system operating authority	Name
Connected system description	Describe and indicate whether the subject system obtains water from, or supplies water to, the connected system

Figure 10.2 Information to include in the drinking water system description.

10.8 Description of the Water Source

The description of the water source should consider general characteristics of the raw water supply, common event-driven fluctuations, and any resulting operational challenges or threats. It could also consider the parameters identified below in Figure 10.3.

Source	Component	Parameter
Groundwater	Aquifer	• Confined and unconfined aquifers • Soils, geology • Depth to water table • Capture zones • Recharge areas • General description of land uses • Wellhead protection zones • Contaminated sites and potential sources of contamination • Monitoring wells
Surface Water Sources	Catchment	• Watershed boundaries • Tributary rivers, streams and lakes • General description of land use such as developed areas, natural areas, forestry, recreational activities, agricultural land uses • Point sources of pollution such as treated sewage outfalls and storm water discharges • Contaminated sites and potential sources of contamination

Figure 10.3 Examples of parameters that could be considered for the type of identified water source.

For systems where source waters are protected and water quality fluctuations are minor, all that may be required is a summary of several key parameters. You may wish to include more detail for poorer quality sources where significant treatment challenges exist to produce water that meets applicable legislative

and regulatory requirements. Historical variations may also be tracked to identify changes in raw water quality over time.

The simplest method of assessing water quality data is to summarize it in a table which presents annual and long term average values and ranges, along with seasonal and/or event-driven fluctuations. You may choose to prepare charts that monitor trends over time. You may also choose to correlate raw water quality data with meteorological data (e.g. E. coli counts may increase following rainfall due to storm water run-off discharges), or for certain parameters assess treatment performance by comparing raw water quality with treated water quality. Figure 10.4 presents some examples of source water quality fluctuations. Figures 10.5 and 10.6 show a typical source water description for a lake-based water treatment system. Figure 10.7 shows a description for a groundwater system.

Type of Fluctuation	**Description**	**Operational Challenges/Threats**
Historical Variation	• Increasing nitrate concentrations in well supply	• Treatment not provided for nitrate removal
Historical Variation	• Data trends demonstrate increasing turbidity and E. coli counts over several years at surface water plant	• Chemically Assisted Filtration and disinfection process performance
Seasonal fluctuation	• Concentrations of iron and manganese in well water increase seasonally	• Performance and capacity of green sand filters
Seasonal fluctuation	• Trihalomethanes (THMs) in treated water increase and approach ODWQS	• Optimization of chemically assisted filtration process for THM precursor removal
Seasonal fluctuation	• Taste and odour in late summer and fall - presence of Methylisoborneol and Geosmin	• Maintaining effective treatment with powdered activated carbon
Event driven fluctuation	• Increases in turbidity, and E. coli counts following rainfall events due to storm water discharges	• Chemically Assisted Filtration and disinfection process performance

Figure 10.4 Examples of fluctuations in water source quality and challenges

General

The primary raw water source for the treatment plant is the Bay of Trent in Lake Mohawk. The Bay's shoreline stretches in a Z-shape from Hudson to Erie for five kilometres. The Bay's watershed is over 500 sq. km, and includes lands drained by the Trenton, Hudson, Pike and Kelowna rivers and a host of smaller tributaries. Kelowna is located in the north eastern part of the Bay on the Kelowna River.

Lake Mohawk water is typically very low in turbidity (<1 NTU), low in colour, slightly basic, and marginally hard (~120mg/L as $CaCO_3$). Temperature fluctuates significantly throughout the seasons ranging from approximately 4 Celsius in the winter to as high as 25 Celsius during the summer. Chemical and bacteriological analysis of the raw water indicates a source of relatively good quality. E. coli counts in the raw water are typically < 2/100 ml, with counts increasing in the summer to up to 15/100 ml.

Seasonal and/or Event Driven Fluctuations

Seasonal changes in raw water temperatures cause vertical turnover of the lake water during spring and fall. Turnover typically takes place over a relatively short duration (about two to seven days). During that period, settled solids from the lakebed are re-suspended resulting in increased raw water turbidity with values up to 20 NTU. Operators must be prepared to make appropriate plant adjustments to treat the elevated levels of turbidity experienced during turnover events.

Changes in water temperature will also affect treatment process performance (settling, disinfection). Optimal treatment requires timely adjustments to treatment chemical dosages (disinfectants and coagulants) in response to temperature fluctuations**.**

Operational Challenges

Lake Mohawk provides high quality source water, which is, for the most part, consistently low in bacteriological contamination and turbidity. While operator response is needed to adjust chemicals in response to elevated turbidity and temperature changes, the most significant challenge related to the source water is the 16 km pipeline through which the water is transported to the treatment facility. Only one pipe exists, which means repairs to pumping equipment or the pipeline itself interrupt the water supply to the treatment facility. The raw water reservoir located adjacent to the plant provides one day's storage time at the plant's rated capacity, and provides some time for maintenance and repair. It is essential that the communications and monitoring equipment from the remote low lift pumping station and raw water reservoir remain in good working order so that problems can be identified quickly. Preventative and breakdown maintenance is carefully planned to minimize the interruption to raw water supply.

The contingency source from the Kelowna River should be used only under extreme circumstances, as river quality is inferior and therefore more difficult to treat. Additionally, rapid mixing of the alum with the raw water is not possible when using the river source, resulting in less-than-ideal conditions for optimal coagulant performance.

Raw Water Supply and pre-chlorination

A pumping station on the shore of Lake Mohawk pumps raw water through a 500 mm pipeline to a raw water storage reservoir. Sodium hypochlorite is added at the Lake Mohawk intake to provide pre-chlorination and also for zebra mussel control when water temperatures are above 12° C. The addition of sodium hypochlorite to the raw water serves as a measure to prevent microbiological growth within the raw water pipeline and reservoir. The plant has an alternate, backup intake pipe to the Kelowna River.

Coagulation/Flocculation/Sedimentation

Water flows by gravity from the raw water reservoir through two 150 mm valves to the water treatment plant where the coagulant alum (hydrated aluminium sulphate) is injected into the raw water line upstream from the flocculation basin. Rapid mixing of the alum with the raw water occurs as the raw water passes through an in-line static mixer. The coagulant allows for the destabilization of the charge of particles present in the raw water, which then join together or agglomerate to form floc. The alum-water solution enters the baffled flocculation basin where gentle mixing results in the formation of floc masses. The process water then flows into sedimentation tanks where the floc is allowed to settle. Supernatant (the clear liquid above the settled floc) overflows the sedimentation tank effluent weir to the top of the dual media filters.

Figure 10.5 Example of a drinking-water system description for a lake-based water treatment system.

Filtration

Treatment comprises two parallel dual media filters. The top layer of the filter is granular activated carbon (GAC). The filter media below the GAC layer is sand. The GAC is effective in removing organic compounds, including those responsible for unpleasant taste and odour sometimes experienced during the warmer months. Residual flocculated particulate matter carried over from the sedimentation process is primarily trapped in the sand portion of the filter. Filtered water passes through the filter under-drain into the treated water clearwells.

Post Filtration Chlorination

Chlorine is also added to the water entering the baffled clearwells. These tanks are designed to provide a minimum chlorine contact time based on the flow through the tanks and the chlorine dosage. This chlorine contact process achieves inactivation of Giardia and viruses that may remain in the water following chemically assisted filtration.

Primary Disinfection

Primary disinfection includes the treatment processes designed for the removal and inactivation of microbiological pathogens as discussed above. Pathogen removal is achieved through coagulation/flocculation/sedimentation/filtration processes, and pathogen inactivation is achieved by post filtration chlorination (post disinfection) that occurs immediately upstream from the clearwells. Both chemically assisted filtration and disinfection are mandated requirements to achieve primary disinfection for surface waters as outlined in the MOE publication, Procedure for Disinfection of Drinking Water in Ontario (June 2006). Monitoring of the primary disinfection process includes coagulant addition, turbidity of the water from each filter, and the chlorine residual concentration after the clearwell.

Secondary Disinfection

Secondary disinfection is accomplished by adding sufficient chlorine at the purification plant to maintain chlorine residual throughout the entire distribution system. Monitoring of secondary disinfection includes on-line monitoring of the chlorine residual entering the distribution system and the collection of grab samples throughout the distribution system that are examined for chlorine residual.

Process Waste Residuals Management

Filter backwash water and sedimentation tank solids are directed to an equalization tank from where they are pumped to a residuals thickening process. The thickened sludge is pumped to the municipal sanitary sewer. The clarified effluent from the thickener is de-chlorinated and discharged to the Kelowna River.

Distribution System and Elevated Storage Tank

Treated water is pumped from the clearwells into the water distribution sub-system. Distribution piping typically ranges in size from 150 mm to 250 mm, and may consist of cast iron, ductile iron, concrete, or PVC, depending on the location and age. Two pressure booster stations are used to ensure adequate system pressure in areas of higher elevation or locations significantly removed from the plant and elevated storage tank. Typical system pressure ranges from 45 to 80 psi. The elevated storage tank is an integral component of the distribution system. The purpose of the storage tank is to provide relatively constant system pressure and a reserve volume of water for community fire protection.

Figure 10.6 Example of a drinking-water system description for a lake-based water treatment system (continued).

General
The Mountain Grove water system is owned and operated by the Town of Mountain Grove.

Water Source
The Town of Mountain Grove obtains its raw water from two drilled wells. The wells penetrate a sand/gravel aquifer of glacial origin. The aquifer has a relatively short flow path that is typical of local flow systems. Characterization of the aquifer can be found as part of the Town of Mountain Grove's Ground Water Source Protection Program.

The capture zone or recharge area is approximately 290 km^2. The aquifer itself is estimated to extend over an area of approximately 52.5 km^2. The outflow, or discharge, is to several streams and the Ardoch Wetlands that in turn feed into the Crow River. The maximum saturated thickness of the sand and gravel beds of the aquifer is just over 55 m, but generally ranges in depths from 32 m to 53 m. At present it is estimated that the aquifer can continuously produce up to 2,860 l/s of water.

The chemistry of the water makes it highly suitable as a source for drinking water. Iron and manganese are present, but not in sufficient quantity to warrant filtration. The water temperature is relatively constant, the hydraulic conductivity is high, turbidity is low and pH is considered normal for groundwater systems.

Raw Water Characteristics

	Temperature	pH	Turbidity
Average	2.2°C	7.4	.09
Range	1.4°C to 4.2°C	7.1 to 7.6	0.06 to 0.15

Data collected over the last 15 years indicates that the water source is stable and consistent. Other than private residential wells, there are no other users taking water from the aquifer. There have been no challenges encountered and none are anticipated.

Water Treatment

Dale Road Pumphouse/Treatment Facility.
The Dale Road pump house/treatment facility is located adjacent to the supply wells. The original facility was constructed in 1968 with one 200 mm supply well (Well No. 1). In 1994 the facility was upgraded and a second 300 mm well (Well No. 2) was constructed. Both wells are drilled to a depth of 41 m. The last upgrade was completed in 2003 to address issues raised in the First Engineer's Report for the system. This upgrade included the addition of a second cell to the contact tank to ensure that the required chlorine contact times could be met under all flow conditions, upgrades to the SCADA systems, the addition of a standby diesel generator and the addition of a second on-line chlorine residual analyzer.

Well No. 2 (300 mm) is the normal duty well. Well No.1 serves as a back-up in the event of maintenance, a mechanical or other failure in the duty well, or low water level in the clear well. The raw water is metered, chlorinated, mixed (static mixer) and analyzed for free chlorine residual before entering the clear well. Chlorine is added in the form of sodium hypochlorite ($NaOCl$). The feed system consists of a day tank with two chemical feed pumps (one duty and one standby).

As water in the clear well is depleted, a level indicator signals the well pump to refill the clear well. If levels in the clear well continue to drop, the second well pump will be called to start. The primary disinfection $NaOCl$ pump is interlocked to start with the well pumps. The dosage is paced to the flow signal from the raw water flow meter. The clear well provides the necessary contact time for primary disinfection to achieve 2-log disinfection of viruses during all flow conditions.

Water flows from the clear well into the pump well. There are five high lift pumps; two jockey pumps (duty and standby), two vertical turbine high lift pumps (duty and standby) and one fire pump. Water is pumped to the discharge header.

On-line equipment monitors and records treated water flow, turbidity, pressure and chlorine residual prior to its entry into the distribution system. There is an auxiliary sodium hypochlorite addition point located after the chlorine residual analyzer, where if necessary additional chlorine can be added to maintain secondary disinfection in the distribution system. The sodium hypochlorite feed system consists of a duty and standby feed pump and a day tank.

Water Distribution
Processed water is pumped through 4.1 km of 150 mm mains to 166 service connections (153 Residential, 13 Commercial). The distribution system also includes six fire hydrants. There are four backflow prevention valves located within the distribution at commercial facilities. The Typical system pressure range is 45 to 50 psi.

Figure 10.7 Example of drinking-water description for a groundwater system.

10.9 Process Flow Chart

The process flow chart, in conjunction with the description of your drinking-water system, should provide a high-level overview of your drinking-water system. The flow chart should show the processes and equipment used to treat, store, monitor and/or distribute drinking water. If the process flow chart is complex, break it into smaller, logical process steps.

A detailed map of the distribution system is not required. A simple process flow chart, showing pumping stations, system storage and re-disinfection facilities, is all that is needed.

The process flow chart should focus on processes in your drinking-water system that contribute directly to water treatment, transmission or distribution activities.

Some of the process steps that you may want to include are:

Water Source

- Intakes (surface water or groundwater)
- Coarse and fine screens
- Raw water storage
- Low lift pumping stations
- Raw water transmission mains, etc

Treatment Elements

- Zebra mussel control
- Coagulation
- Flocculation
- Sedimentation
- Filtration (e.g. gravity, pressure, bag filters, cartridge filters, greensand filtration)
- Membrane Filtration
- Granular activated carbon
- Aeration
- Disinfection (e.g. chlorination, ozonation, UV disinfection)
- Contact tanks, etc.

Chemical Addition

- Chlorine
- Chlorine dioxide
- Ammonia
- Coagulant and coagulant aids
- Lime
- Sodium Hydroxide

Monitoring

- Flow
- pH
- Temperature
- Conductivity
- Streaming current monitors
- Turbidity and/or particle counts
- Disinfectant residual
- UV parameters, etc.

Distribution

- Pumping stations
- System storage
- Re-disinfection facilities
- Pressure boosting stations

Figure 10.8 on the following page shows an example of a process flow chart for a surface water treatment system. Note that this example does not include waste treatment processes.

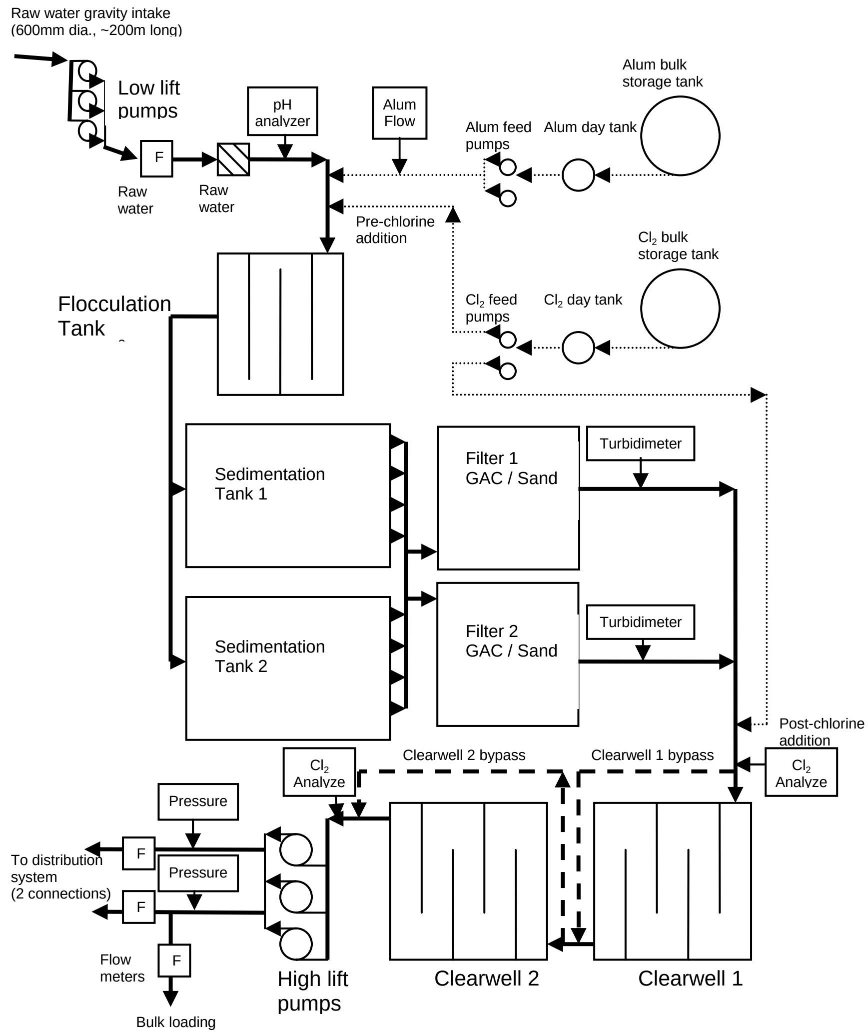


Figure 10.8 Example of a process flow chart for a surface water treatment system.

10.10 Upstream and Downstream Processes

Sometimes you rely on processes that are outside of your drinking-water system and of your control. If those processes are not in place, the provision of safe drinking water could be affected. In the DWQMS, these processes are referred to as critical upstream or downstream processes.

An example of a critical upstream process would be the water treatment plant for a stand-alone water distribution system. If the treatment plant is not operating properly, the water quality in the distribution system could be affected. A critical downstream process could be backflow preventers for a water distribution system that depends upon the presence and operation of backflow preventers at each service connection. If the backflow preventers are missing or not operating properly and system pressure falls in the distribution system, contaminants could be accidentally introduced into the system.

In your system description, ensure that critical upstream or downstream processes that you rely upon are identified. It is up to you to define what processes, if any, you would like to include.

10.11 Connections to Other Drinking Water Systems

If your subject system is part of a larger municipal residential drinking-water system, you have to provide a summary description of the larger drinking-water system in your operational plan. For example, scenarios where a subject system may be part of a larger drinking-water system include:

- If the subject system regularly supplies drinking water to neighbouring drinking-water systems
- If the subject system periodically supports other drinking-water systems as needed (e.g. occasional supply to reservoirs in periods of high demand)
- If the subject system is connected to other drinking-water systems for emergency preparedness reasons (e.g. normally closed connecting valves).

Ready for the **Audit**

What do auditors like to see?

- That descriptions are current and thorough
- A process flow chart that matches the description of the drinking-water system, and the actual system observed by the auditor during the external audit.

The description of the larger municipal residential drinking-water system should be general, and should include the name of each owner and operating authority of the larger system.

10.12 Operational Plan: Drinking-Water System

The final task in this chapter is for you to include your Drinking-Water System description in your operational plan. Under a Drinking-Water System section or tab divider, insert the descriptions you have prepared, and the process flow chart. If you would rather not insert documents into the operational plan binder, then just write down where those documents can be found.

Now that the information is prepared, it must be kept up-to-date. Identify the most effective method for making sure changes in the system, source, ownership, or upstream/downstream processes are promptly updated in the QMS documentation. This method may come from a combination of processes – perhaps a periodic check to review the information, an automatic trigger from an approval of infrastructure funds, or a prompt from a sign-off form when new equipment is implemented – the key is to ensure that the updates are made in a timely manner. Assign specific operating authority personnel to update the information prepared under Element 6.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
Has a description of the drinking-water system including all treatment processes and distribution system components been prepared?	
Were general characteristics of the raw water supply included in the description?	
Were common event-driven fluctuations included in the description?	
Were resulting operational challenges included in the description?	
Is a process flow chart available?	
Have critical upstream or downstream processes relied upon been described?	
If the subject system is part of a larger drinking-water system, has a summary description of the larger system been prepared?	
If the subject system is part of a larger drinking-water system, has the name of each owner and operating authority been included?	

11. Risk Assessment and Risk Assessment Outcomes

11.1 Key Points in Chapter 11

In this chapter, the risk assessment process is discussed including:

- How potential hazards and hazardous events are identified.
- How risks are assessed.
- How hazardous events are ranked according to the associated risk.
- How control measures are identified.
- How critical control points are identified.
- How critical control limits are identified for the critical control points.
- How critical control limits are monitored.
- How to respond to deviations from critical control limits.
- How deviations from critical control limits are reported and recorded.
- How the risk assessment is verified and redone.
- How equipment reliability and redundancy are considered in the risk assessment process.

11.2 Translating the DWQMS

What the standard says…

7. Risk Assessment

PLAN – The Operational Plan shall document a risk assessment process that:

a) identifies potential hazardous events and associated hazards,
b) assesses the risks associated with the occurrence of hazardous events,
c) ranks the hazardous events according to the associated risk,
d) identifies control measures to address the potential hazards and hazardous events,
e) identifies critical control points,
f) identifies a method to verify at least once a year, the currency of the information and the validity of the assumptions used in the risk assessment,
g) ensures that a risk assessment is conducted at least once every thirty-six months, and
h) considers the reliability and redundancy of equipment.

DO – The Operating Authority shall perform a risk assessment consistent with the documented process.

8. Risk Assessment Outcomes

PLAN – The Operational Plan shall document:

a) the identified potential hazardous events and associated hazards,
b) the assessed risks associated with the occurrence of hazardous events,
c) the ranked hazardous events,
d) the identified control measures to address the potential hazards and hazardous events,
e) the identified critical control points and their respective critical control limits,
f) procedures and/or processes to monitor the critical control limits,
g) procedures to respond to deviations from the critical control limits, and
h) procedures for reporting and recording deviations from the critical control limits.

DO – The Operating Authority shall implement and conform to the procedures.

What does it mean?

Elements 7 and 8 of the DWQMS require that you complete a risk assessment for your drinking-water system, then implement and document the means by which you manage those risks. All potential hazards and hazardous events are identified, and for each, the level of risk is assessed. A structured approach is important to ensure nothing is overlooked and that the areas of highest risk are identified.

This task includes the following steps:

- Identifying potential hazardous events and hazards that could affect drinking water safety;
- Assessing the risk associated with the occurrence of a hazardous event;
- Ranking the hazardous events according to the associated risk;
- Identifying control measures that you have in place to address the hazards and hazardous events;
- Identifying critical control points;
- Establishing critical control limits for each critical control point;
- Ensuring that the risk assessment is kept current; and
- Documenting the risk assessment process and outcomes.

The risk assessment will be facilitated by developing a Risk Assessment Table. As you conduct this assessment, you will need to document the results of each step and the risk assessment procedure. The risk assessment process is an ongoing activity. Once a year the currency of the information and the validity of the information used in the risk assessment must be verified. The risk assessment must be redone every three years at a minimum, unless changing conditions indicate that it should be done more frequently.

More detailed examples are provided in the Model operational plans (Part III of the guidance document) and a blank table for this has been provided in Part II of the guidance document.

11.3 Risk Assessment Overview

This chapter of the guidance document is a crucial one. By performing a risk assessment, you are identifying hazards in your drinking-water system, and the control measures to address those hazards. You are also zeroing in on the most critical process steps to make sure control limits are set and that monitoring and response procedures are in place. The task is common sense, interesting to complete, and typically leads to a greater understanding of your drinking-water system and its vulnerabilities, better management systems and improved controls.

It is important to keep in mind that the process is subjective, no two risk assessment teams will assess risks in exactly the same way for the same system. However, utilizing a team leads to a balanced outcome.

The risk assessment tasks required by the DWQMS are, in many respects, a follow-up to the First Engineer's Report completed for most drinking-water systems. The principal objective of these reports was to assess the potential for microbiological contamination, and to identify operational and physical

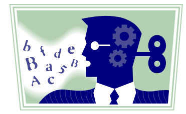
improvements necessary to mitigate this potential using multiple barrier concepts. As a result, improvements were implemented at many systems. The focus of the current risk assessment task is primarily on operational and managerial aspects for the existing system.

All hazards are considered in this exercise, although microbiological hazards remain a major focus due to the potential health consequences, and the presence of treatment systems for their control.

The following are the main tasks for the risk assessment:

- Setting up a risk assessment team
- Choosing a risk assessment approach
- Setting up a risk assessment table
- Identifying hazardous events and associated hazards
- Identifying available control measures
- Assessing risks
- Ranking hazardous events
- Identifying critical control points
- Setting critical control limits
- Monitoring critical control points
- Establishing procedures for deviations from critical control limits
- Keeping the risk assessment current.

These tasks are explained in more detail below.



Technical **Terms**

A Risk Assessment is an orderly methodology of identifying hazards or hazardous events that may affect the safety of drinking water and evaluating their significance.

Risk is the probability of identified hazards causing harm, including the magnitude of that harm or the consequences.

11.4 Setting Up a Risk Assessment Team

Performing a risk assessment is largely a brainstorming exercise and it is recommended that a minimum of three people be part of the assessment team.

This activity requires experience with the drinking-water system and knowledge of the kind of hazards and hazardous events to which your system may be subject. Maintenance staff, operators and managers have a wealth of experience and knowledge, and they should be involved in this task. For small systems with limited staff you may want to include personnel from neighbouring systems. You may decide to include team members with expertise in areas such as public health issues, process control and technical experts.

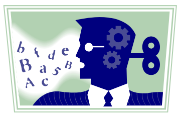
The risk assessment will likely take several days to complete – perhaps even longer for larger systems. If it is more conducive to your operations schedule and demands, arrange to perform the risk assessment in stages.

11.5 Choosing a Risk Assessment Approach

The first step in performing the risk assessment is to decide on a method. One possible method is described in the Health Canada document titled Canadian Guidance Document for Managing Drinking-Water Systems: A Risk Assessment/Risk Management Approach (September, 2005). A second possible approach is the Failure Mode and Effects Analysis commonly used in manufacturing and assembly industries, as an integral part of ISO 9001 quality management systems.

The Government of Ontario has also undertaken a process of implementing risk management as a priority setting and resource management tool for compliance activities through the adoption of a common risk management framework. The framework recognizes that many analytical models have been developed and tested worldwide by both the finance and scientific communities. The government commonly uses a probabilistic model which involves a calculation to determine risk based on **multiplying** the defined risk factors. The risk assessment example presented later in this chapter uses another analytical model that **adds** the defined risk factors together to determine the associated risk. The model operational plans in Part III of this document show examples of each.

Any approach that your team is comfortable with is acceptable provided it meets the requirements of Elements 7 and 8 of the DWQMS. Before starting the Risk Assessment, the team will need to review the steps involved in the assessment method you choose.



Technical **Terms**

A **Hazard** is a source of danger or a property that may cause drinking water to be unsafe for human consumption. The **hazard** may be biological, chemical, physical or radiological in nature.

A **Hazardous Event** is an incident or situation that can lead to the presence of a hazard.

Hazards and hazardous events can result from natural or technological causes, or from human activities.

11.6 An Overview of Hazards

To begin the Risk Assessment, have your team become familiar with the different types of hazards that may affect drinking water quality. The four types of hazards (biological, chemical, physical, and radiological) are described below:

Biological Hazards

Biological pathogens are usually considered the most significant drinking water health risk because the effects are acute; if ingested, pathogens can cause gastrointestinal illness within a period of hours or days. Waterborne biological hazards include bacterial, viral and parasitic organisms. These organisms are commonly associated with faecal wastes from humans and other animals, and some can occur naturally in the environment. Although most bacteria are not pathogenic, pathogens such as *E. coli* O157, *Legionella*, *Salmonella* Typhi, and *Shigella* are commonly associated with waterborne disease. Viruses of concern include, but are not limited to, Hepatitis A and Norovirus. Protozoa of concern include *Giardia* and *Cryptosporidium* which are common contaminants in natural bodies of surface water.

Chemical Hazards

Chemical contaminants may occur naturally or may be added or created during water processing. Harmful chemicals at high levels have been associated with acute cases of waterborne illnesses and can be responsible for chronic illness at lower levels of exposure. Chemical hazards in drinking water may come from the source water or occur in the treatment and distribution system. They include but are not limited to: toxic spills, naturally occurring minerals, heavy metals, dissolved gases (e.g. radon), pesticides, fertilizers, endocrine disruptors, personal care products and pharmaceutical residuals, cyanotoxins, flocculants, coagulants, lubricants, copper, iron, zinc, and lead from pipes and fittings.

Physical Hazards

Physical hazards can result from contamination and/or poor procedures at different points in the delivery of water from source to customer. Sediments are the most common physical hazard associated with drinking water and are of concern as they may carry with them microbiological hazards and interfere with disinfection system efficacy. Other physical hazards include biofilms, pipe materials or sloughed metal.

Radiological Hazards

Radiological hazards may arise from man-made or natural sources, with naturally occurring chemicals (uranium, radon, etc.) most frequently found in groundwater. If there is the potential for the accidental release of man-made radiologicals, such as tritium or other radionuclides, these sources should also be considered. With accidental releases, surface waters may be at a greater risk.

Additional information on hazards is available in the following Ministry publications:

- Technical Support Document for Ontario Drinking Water Standards, Objectives and Guidelines (June, 2003)
- Ontario Drinking-Water Quality Standards Regulation O.Reg. 169/03, supporting information and fact sheets
- Procedure for Disinfection of Drinking Water in Ontario, June, 2006

Hazards related only to drinking water safety must be considered. Under the scope of the QMS, health and safety or environmental hazards, for example, need not be included if they do not pose a hazard to drinking water safety.

11.7 Setting Up a Risk Assessment Table

In order to effectively conduct a risk assessment, you must consider all of the different processes of your drinking-water system, from the source to the point of delivery. These steps were identified in your Process Flow Chart (that was prepared in the previous chapter). For each process step, potential hazards are brainstormed, and documented in a risk assessment table. A template for this table is provided in Appendix D in Part II of the guidance document. This template will provide your team with a structured step-by-step approach.

Copy each of the process steps from the process flow chart to the "Activity or Process Step" column of the risk assessment table. An example of a risk assessment table is shown in Figure 11.1 below.

Activity or Process Step	Description of Hazardous Event/ Hazard	Control Measures
Source Water		
Intake		
Low Lift Pumps		

Figure 11.1 Risk assessment table showing some process steps from the process flow chart.

11.8 Identifying Hazardous Events and Associated Hazards

The first step of the Risk Assessment is to assess existing and potential hazardous events and hazards that could affect the safety of the drinking water.

For each process step in your Risk Assessment Table, brainstorm hazards or hazardous events that could affect drinking water quality, and record them in the "Description of Hazardous Event/Hazard" column. Here you can describe the hazard, and the hazardous event that may cause it.

For example, one hazardous event that may occur in distribution systems is the loss of the main power supply. All systems are potentially at risk in the event of a long-term power outage, particularly if standby power generators are not available.

Systems with elevated storage are at a lower risk as consumer needs can be supplied for a period of time from stored water. Systems which do not have elevated storage are at a greater risk as they will be unable to supply water immediately, and system pressure could fall unacceptably low. With low system pressures, the potential exists for infiltration of chemically or biologically contaminated water into the watermains.

In your Risk Assessment Table under the distribution system portion of your Activity or Process Steps, you could include power outage as a potential hazardous event.

Note: This hazardous event could also be identified under the treatment section of the Risk Assessment Table due to the inability to produce water.

Hazardous events can be natural or technological in origin, or result from human activities. Natural events include floods, ice storms, drought and spring run-off. Technological events could include equipment failure or power outage. Human activities that could lead to a drinking water risk include vandalism, terrorism, chemical spills, and construction accidents.

Remember that all potential hazards and hazardous events should be identified even if there are control measures in place.

For example, a back-up diesel emergency generator may be in place at the water treatment plant to provide power to the water treatment plant in the event of a power failure. Even though that control measure is in place, a power outage is still identified as a hazardous event.

For hazards or hazardous events that are associated with the entire system, rather than just one process, such as power outage, the table needs only to be filled out once. Identify these with an asterisk, and provide an explanatory footnote.

Helpful **Tips**

- Remember to consider normal operations, maintenance activities, and emergency situations.
- Remember the four types of hazards for drinking water - biological, chemical, physical and radiological.
- All potential hazards and hazardous events, large and small, should be identified and included.
- Even though a hazard or hazardous event may not appear to be significant, it should be discussed by the team and included in the Risk Assessment Table.

There may be more than one type of hazard or hazardous event for each activity or process step. Hazards or hazardous events may be introduced from processes upstream or downstream (e.g. backflow from a cross connection) Don't forget to think beyond the boundaries of the drinking-water system.

Be sure to describe the hazard, such as *chemical contamination of source water* or *potential for biological/chemical contamination due to loss of supply, low pressures, and potential for infiltration into the distribution system.* An example is shown in Figure 11.2. These are the same activity or process steps identified in the previous example. This example will be developed throughout the chapter.

Activity or Process Step	**Description of Hazardous Event/ Hazard**
Source Water	Rail Car Derailment; Spill/accidents on spur rail lines; <200 m to lake; plus railway bridge over tributary creek. Chemical contamination of source water.
Source Water	Community on lake uses private septic systems. Discharge of inadequately treated septic system effluent into lake near water treatment plant intake. Biological contamination of source water.
Source Water	Algal blooms, clogging of filters, potential for toxin producing cyanobacteria. Biological/Chemical contamination of source water.
Intake	Collapse or breakage of single intake pipe and blockage of intake screens with bags and other debris. Potential for biological/chemical contamination due to loss of supply, low pressures, and infiltration into the distribution system.
Treatment	Coagulant interruption. Biological contamination due to ineffective chemically assisted filtration and pathogen removal.
Treatment	Filter turbidity breakthrough. Biological contamination due to ineffective chemically assisted filtration and pathogen removal.

Note: The above table has been developed for the purpose of explaining concepts. The control measures identified **should not** be taken as being necessarily suggested or required by the Ministry.

Figure 11.2 Risk assessment table showing activity or process steps plus hazardous events and associated hazards.

11.9 Identifying Available Control Measures

Now you will begin to identify measures in place to control the hazards and hazardous events that have been identified. This is where you describe what is currently in place to keep the hazards or hazardous event under control. You are not required to prepare control procedures, but simply to describe what control measures are in place. This task must be performed for all hazards and hazardous events. Figure 11.3 shows an example of a risk assessment table that includes control descriptions.

A few examples of control measures that may be in place include:

- Grass strips implemented along all water courses.
- Control or operating procedures (e.g. operators may be trained in proper procedures for backwashing).
- Backup equipment (e.g. a spare UV disinfection unit may be available in case one needs to be taken off-line).
- Fail-safe alarms (e.g. SCADA alarms may sound for low water levels, high filtered water turbidity, low chlorine, etc.).
- Backup emergency power (e.g. an automatic emergency generator may start in the event of a power loss).

It is important to note that not all hazards or hazardous events can be controlled through your subsequent processes. The best that can be achieved with some hazards or hazardous events is monitoring or response. These hazardous events may be considered emergencies and dealt with through emergency response and recovery procedures (see Chapter 18).

Making sure enough equipment is on hand is one way of controlling a hazard or hazardous event. Be sure to consider the reliability or redundancy of equipment when identifying control measures.

Ready for the **Audit**

What do auditors look for?

Documented hazards and hazardous events for the drinking-water system, which match hazards and hazardous events that the auditors became aware of during the document review or the site visit.

Documented control measures that are in place for hazards and hazardous events.

For example, in Figure 11.3, the collapse or breakage of a single intake pipe was identified as a potential hazardous event. Potential for biological/chemical contamination due to the loss of supply, low pressures, and the potential for infiltration into the distribution system were all identified as resulting hazards. If a dual intake system is in place, this redundancy should be noted as a means of controlling the potential hazard.

Activity or Process Step	Description of Hazardous Event/Hazard	Control/Response Measures
Source Water	Rail Car Derailment; Spill/accidents on spur rail lines; <200 m to lake Chemical contamination of source water	Some contaminants may be removed by treatment. Until contaminant is identified assume no method of control. Consider developing response procedure or emergency response procedure.
Source Water	Community on lake uses private septic systems. Discharge of inadequately treated septic system effluent into lake near water treatment plant intake. Biological contamination of source water	First barrier - Source water protection – addressed in a separate Ministry initiative. Second barrier – Treatment - microbiological contamination controlled by chemically assisted filtration and disinfection.
Source Water	Algal blooms, clogging of filters, potential for toxin producing cyanobacteria Biological/Chemical contamination of source water	Controlled by chemically assisted filtration and addition of powdered activated carbon to assist in removal of toxins.
Intake	Collapse or breakage of single intake pipe and blockage of intake screens with bags and other debris. Potential for contamination due to loss of supply, low pressures, and infiltration into the distribution system.	No Control available. Consider developing response procedure or emergency response procedure.
Coagulant Addition	Coagulant interruption. Biological contamination due to ineffective chemically assisted filtration and pathogen removal.	Automatic controls shut down low lift pumps and treatment system on loss of signal. Investigate problem, maintenance, spare parts.
Filters	Filter turbidity breakthrough. Biological contamination due to ineffective chemically assisted filtration and pathogen removal.	Automatic controls stop water production on high turbidity. Backwash initiated, followed by filter to waste cycle.

Note: The above table has been developed for the purpose of explaining concepts. The control measures identified **should not** be taken as being necessarily suggested or required by the Ministry.

Figure 11.3 Risk assessment table showing some control and response measures that may be in place for the hazards listed.

11.10 Assessing Risks

With hazards and hazardous events now identified, the risks associated with the hazardous events must be assessed. One option for assessing risk is presented below. This option calculates risk based on likelihood, consequence and detectability. Another option is presented in the Health Canada document, Canadian Guidance Document for Managing Drinking-Water Systems: Risk Assessment/Risk Management Approach (September, 2005), and is similar, but does not include detectability. These two options are not the only methods to identify significant hazards. You may choose to adopt one of these methods or a variation of one of these methods, or you may adopt another method if it best suits your system.

Likelihood is the probability of a hazard or hazardous event occurring, sometimes called Frequency. It is determined by how often or how likely a hazard or a hazardous event occurs. It must take into account hazards or hazardous events that have occurred in the past and the likelihood of their recurrence and

must also predict the likelihood of hazards and hazardous events that have not occurred to date. Both emergency events and predictable events should be considered.

Consequence is the severity of the results of the hazard/hazardous event if the hazard is not controlled. Some risk assessment methodologies measure consequence only in terms of potential human health impact. Other methodologies include other considerations in assessing consequence which can include: consumer/public concern and impact on operations and costs. The consequence of an event can be affected by the concentration of contaminants present and their nature, the time frame of the exposure, the geographical area of the exposure, or the number of persons exposed. Sensitivity of the exposed population may also be a factor in determining consequence.

Detectability has also been used as a risk factor in this example, but its use is optional. With this approach, as the ability to detect a hazard decreases, the associated risk may be considered to increase. Hazards that cannot be defined or detected have a higher risk factor, as you do not know when appropriate control measures should be implemented. Risks that can be monitored in real time are lower risks, as appropriate control measures can be taken.

Helpful **Tips**

Typically high likelihood/ high consequence/low detectability events are given priority.

Low likelihood/low consequence events/high detectability events are usually not prioritized for management actions, until high priority events are managed.

Likelihood, consequence and detectability are expressed by a system of numerical weighting. In the approach outlined in this example, the likelihood, consequence and detectability for each hazardous event was each assigned a value of between 1 and 5, with a value of 5 representing the highest risk. An example of a numerical risk-rating scheme is presented in Figure 11.4.

Description	Likelihood of Hazardous Event Occurring	Rating
Rare	May occur in exceptional circumstances, and has not occurred in past.	1
Unlikely	Could occur at some time, historically has occurred less than once every five or 10 years.	2
Possible	Has occurred or may occur once or more per year.	3
Likely	Has occurred or may occur on a monthly to quarterly basis.	4
Very likely	One or more occurrences on a monthly or more frequent basis.	5

Description	Consequence of Hazardous Event Occurring	Rating
Insignificant	Insignificant impact, little public exposure, little or no health risk.	1
Minor	Limited public exposure, minor health risk.	2
Moderate	Minor public exposure, health impact on small part of the population.	3
Major	Large part of population at risk.	4
Catastrophic	Major impact for large part of the population, complete failure of systems.	5

Description	Detectability of Hazardous Event	Rating
Very Detectable	Easy to detect, on-line monitoring through SCADA.	1
Moderately Detectable	Moderately detectable, alarm present but not in SCADA, may require operator to walk by and notice alarm; problem is indicated promptly by in-house lab test results.	2
Normally Detectable	Normally detectable, visually detectable on rounds or through regular maintenance.	3
Poorly Detectable	Poorly detectable, visually detectable but not inspected on a regular basis; not normally detected before problem becomes evident; lab tests are not done on a regular basis (e.g. quarterly).	4
Undetectable	Cannot be detected.	5

Figure 11.4 Likelihood, consequence and detectability rating system.

One of the benefits of incorporating detectability into the risk assessment is that the team members may become more aware of the hazards and hazardous events that are difficult to detect or that are undetectable. As a result, control measures or procedures may be put in place to address them.

For example, watermain breaks frequently occur in water distribution systems, particularly during the winter months. Depending on the severity of the breaks and depending on the system, they may cause a decrease in water pressure and they may allow contaminants from outside the watermain to enter into the distribution system. Since watermain breaks occur below the ground surface, they may or may not be easily detectable. Therefore, a watermain break would generally be assigned a higher numerical value to reflect its poor detectability. You may decide to implement control measures such as a leak-detection program to mitigate this risk.

Figure 11.5 shows likelihood, consequence and detectability ratings assigned to examples of hazardous events/hazards, all recorded in the Risk Assessment Table. The ratings provided in the table have been developed to describe concepts and **should not** be interpreted as being necessarily suggested or required by the Ministry.

11.11 Ranking Hazardous Events

A simple way of ranking the hazardous events according to the associated risk is presented here, using the likelihood, consequence and detectability ratings that you have already determined. By adding the numbers assigned for likelihood, consequence and detectability, you can rank your hazardous events.

RANK = LIKELIHOOD + CONSEQUENCE + DETECTABILITY

Figure 11.5 shows the calculated risk ratings assigned to different hazardous events, recorded in the Risk Assessment Table.

In risk assessment approaches, which use only likelihood and consequence as risk criteria, the numbers are commonly multiplied to provide a risk rating.

In your Risk Assessment Table, sum up the likelihood, consequence and detectability ratings for each hazardous event. Select a threshold number for high risk hazardous events which must be considered further. This threshold number should capture all hazardous events which are sufficiently severe to warrant that the hazardous event be managed.

For the example in Figure 11.5, a threshold number of 7 was selected. Process steps associated with hazardous events ranked above 7 are considered high-risk hazardous events, which require further investigation to assess whether they are critical control points.

In Figure 11.5, the hazardous event of coagulant interruption, causing biological contamination is ranked above 7. Based on this threshold, the coagulant addition process, identified in the first column of Figure 11.5, would then be considered a high-risk hazardous event.

The ranking model is a tool to help you identify CCPs, but it does not need to be rigid. The QMS must be flexible to the needs of the operating authority, including the CCP determination.

Helpful **Tips**

The team performing the risk assessment should rely on site-specific knowledge of the water system. The hazardous events should be ranked through a collaborative process by the risk assessment team.

Note that in the traditional approach to risk assessment and critical control point (CCP) identification, only the last step at which a hazard can be controlled is defined as a CCP. However, in a risk assessment for a drinking -water system based on the multi-barrier approach, there will be several control points that might address any particular hazard or hazardous event. Therefore, several CCPs may be identified for each hazardous event.

11.12 Identifying Critical Control Points

A critical control point (CCP) is an essential step or point in the subject system where you apply some sort of control, to prevent or eliminate a drinking-water health hazard or to reduce it to an acceptable level. In the traditional approach to risk assessment and CCP identification, only the last step at which a hazard can be controlled is defined as a CCP. However, in the risk assessment process for a drinking-water system based on the multiple barrier approach, there could be several control points that could address any particular hazard or hazardous event. Therefore, several CCPs may be identified for each hazardous event.

Elements 7 and 8 of the DWQMS require you to:

- Identify critical control points,
- Identify control measures and critical control limits,

- Document procedures and/or processes to monitor the critical control limits,
- Document procedures to respond to deviations from critical control limits,
- Document procedures for reporting and recording deviations from critical control limits.

To identify critical control points in your drinking-water system, you must first rank your hazardous events as outlined in the previous step and assess whether they exceed your risk threshold. The second step is to identify whether or not the hazardous event can be controlled. If the hazardous event cannot be controlled to prevent, eliminate or reduce a drinking-water health hazard, it is not a CCP.

Identify your critical control points on your Risk Assessment Table, by completing the "CCP?" column.

As the plan is refined over several years and the risks are addressed, the threshold number can be reduced to allow lower ranked hazardous events to be managed.

If control measures are not in place for hazardous events with high rankings, you are not required to put them in place (unless of course they are required to meet the requirements of applicable legislation and regulations). There are several ways in which you could deal with the CCPs associated with these hazardous events as outlined below:

- The operating authority may decide that improvements to control measures are warranted for certain hazardous events with a high ranking. These improvements could be part of long-term planning for the system, such as a plan to twin a single intake pipe or transmission main in a five or 10 year planning period.
- For hazardous events which cannot be controlled, it may be appropriate to develop contingency procedures or emergency response procedures (see Chapter 18).

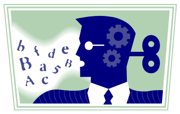
You may choose to identify long term plans or emergency response procedures in the "CCP?" column of the Risk Assessment Table, but this is not a specific requirement of the DWQMS.

Figure 11.5 shows the "CCP?" column completed for sample hazards and hazardous events.

Activity or Process Step	Description of Hazardous Event/ Hazard	Control Measures	Likelihood	Consequence	Detectability	Total (High Risk CCP Threshold=7)	CCP?
Source Water	Rail Car Derailment; Spill Chemical contamination of source water.	**No control** - Some contaminants may be removed by treatment. Until contaminant is identified assume no method of control.	1	5	2	8	No – No control available at this point (Emergency Response Procedure).
Source Water	Community on lake uses private septic systems. Biological contamination of source water.	Not currently at this step. First barrier - source water protection – to be addressed in a separate Ministry initiative. Second barrier – chemically assisted filtration and disinfection.	1	2	3	6	No - Below risk threshold for CCP (also control not available at this point).
Source Water	Algal blooms Biological/Chemical contamination of source water. Taste and odour.	Controlled by chemically assisted filtration and addition of powdered activated carbon (PAC).	3	3	1	7	Yes.
Intake	Collapse or breakage of single intake pipe Potential for loss of water quantity and quality.	**No Control available**	2	3	1	6	No - Below risk threshold for CCP (also control not available at this point) (Contingency or Emergency Response Procedure)
Coagulant Addition	Coagulant interruption Biological contamination – ineffective chemically assisted filtration	Automatic controls shut down low lift pumps and treatment system on loss-of-alum flow signal. Operators investigate problem and perform maintenance or repair, spare parts and pumps available.	3	4	1	8	Yes.
Filters	Filter turbidity breakthrough. Biological contamination ineffective chemically assisted filtration.	Automatic controls stop water production on high turbidity. Backwash initiated, followed by filter to waste cycle.	1	4	1	6	Yes. **Below risk threshold for CCP but included as it is a Recommended Minimum CCP.**

Note: The table has been developed to describe concepts and **should not** be interpreted as being necessarily suggested or required by the Ministry.

Figure 11.5 Example of a risk assessment table.



Technical **Terms**

Primary Disinfection – a process or series of processes intended to remove or inactivate human pathogens such as viruses, bacteria and protozoa in water.

The minimum treatment processes to achieve primary disinfection are different for groundwater and surface water sources. Details are provided in O. Reg. 170/03 and the *Procedure for Disinfection of Drinking Water in Ontario*.

Secondary disinfection – a process or series of processes intended to provide and maintain a disinfectant residual in a drinking-water system's distribution system, and in plumbing connected to the distribution system, for the purposes of:

a) protecting water from microbiological re-contamination,
b) reducing bacterial regrowth,
c) controlling biofilm formation, and
d) serving as an indicator of distribution system integrity.

This process includes the use of disinfectant residuals from primary disinfection to provide and maintain a disinfectant residual in a drinking-water system's distribution system for the purposes described in clauses (a) to (d).

11.13 Recommended Minimum CCPs

Through the previous tasks, CCPs were identified based on your team's assessment. It is recommended that you also include the CCPs which control the treatment and disinfection processes for your system. These are referred to as Recommended Minimum CCPs.

The **Recommended Minimum CCPs** are those control points required by regulation to meet minimum treatment requirements for primary disinfection and secondary disinfection as outlined in O. Reg. 170/03 and the Procedure for Disinfection of Drinking Water in Ontario.

The control points generally meet the characteristics of an ideal critical control point as they typically are:

- Able to prevent, eliminate or reduce hazards,
- Monitored, preferably in real time,
- Able to have determined control limits, and,
- Essential to ensure the safety of the drinking-water.

These control points also provide important barriers in the multiple-barrier process to ensure that pathogens that could be present in the water are effectively inactivated and/or removed, and that secondary disinfection is maintained in the distribution system. For these reasons, it is recommended that they be included as CCPs.

Treatment Requirements and Secondary Disinfection

The following provides an overview of drinking water treatment requirements under O. Reg. 170/03 and the Ministry's Procedure for Disinfection of Drinking Water in Ontario for both groundwater and surface water supplies.

For groundwater supplies, treatment is required to be:

- capable of achieving at least 99 percent removal or inactivation of viruses by the time the water enters the distribution system; and
- in accordance with the Ministry's *Procedure for Disinfection of Drinking Water in Ontario*.

For surface water supplies, treatment is required to be:

- designed to be capable of chemically assisted filtration;
- capable of achieving at least 99 percent removal or inactivation of *Cryptosporidium* oocysts, at least 99.9 percent removal or inactivation of *Giardia* cysts, and at least 99.99 percent removal or inactivation of viruses by the time the water enters the distribution system; and
- in accordance with the Ministry's *Procedure for Disinfection of*

Drinking Water in Ontario; or

- other water treatment equipment that, in the Director's opinion, is designed to be capable of producing water of equal to or better quality than that noted above.

For both surface water and groundwater supplies, secondary disinfection shall be achieved by:

- chlorination or chloramination equipment designed in accordance with the Ministry's *Procedure for Disinfection of Drinking Water in Ontario* and capable of achieving a free chlorine residual of 0.2 mg/L if the system uses chlorination or a combined chlorine residual of 1.0 mg/L if the system uses chloramination; or
- other water treatment equipment that, in the Director's opinion, is designed to be capable of providing secondary disinfection equal to or better quality than that noted above as outlined in the O. Reg 170/03 and/or the *Procedure for Disinfection of Drinking Water in Ontario*.

How to Determine Recommended Minimum CCPs

In general, processes within a water treatment plant required to ensure compliance with O. Reg. 170/03 and the Procedure for Disinfection of Drinking Water in Ontario should at a minimum be included as CCPs. Within the distribution system, only those control points required for ensuring secondary disinfection would be considered recommended CCPs.

When determining which CCPs meet the criteria for recommended minimum CCPs within your system you should consider the following:

- Does the step or process contribute to the minimum log removal or inactivation of pathogens in the drinking water?
- Is the step or process necessary to meet the requirements of the *Procedure for Disinfection of Drinking Water in Ontario*?
- Is the step or process necessary for maintaining a distribution system disinfectant residual?

Answering yes to one or more of the questions above would designate the CCP in question as a recommended minimum CCP. Examples are provided below to illustrate minimum CCPs for various systems.

As previously discussed, for each recommended minimum CCP it is important to identify the available monitoring in place as well as establishing critical control limits. You should review your Risk Assessment Table to ensure that the recommended minimum CCPs have been identified.

The examples which follow discuss how recommended minimum CCPs are identified. As an optional task, identify the recommended minimum CCPs in the CCP column.

Example 1 – Treatment (Primary Disinfection) for Groundwater System:

A small drinking-water supply system consists of a single groundwater well, sodium hypochlorite chemical feed system, and a section of dedicated watermain prior to entering the distribution system to provide chlorine contact time for two-log virus inactivation. An on-line analyzer monitors the chlorine residual as it leaves the plant.

In this example, the sodium hypochlorite feed system is required for providing primary disinfection and is therefore a minimum CCP.

Example 2 – Treatment for Surface Water Source Water:

A surface water treatment plant treats a low turbidity water source using a combination of direct filtration, and ultraviolet (UV) disinfection. UV is used for additional inactivation of Giardia, as inadequate chlorine contact time is available. Chlorine is added just prior to the water entering the distribution system for virus inactivation and for secondary disinfection.

In order to satisfy the Procedure for Disinfection of Drinking Water in Ontario the direct filtration process must, among other requirements:

- use a chemical coagulant at all times,
- monitor and adjust chemical dosages in response to variations in raw water quality,
- maintain effective backwash and filter ripening procedures,
- continuously monitor filtrate turbidity from each filter,
- ensure a filtered water turbidity of less than or equal to 0.5 NTU in 95 percent of the measurements each month.

Based on these requirements and the system's treatment process, the following components would be considered as minimum CCPs for treatment:

1. Coagulant Dosing System – a requirement for chemically assisted-filtration. Alum pumps and alum flow switch are monitored through SCADA and alarm if feed is lost.

2. Filters – a requirement for chemically assisted-filtration. Filtered water turbidity is monitored by SCADA and automatic control procedures.

3. UV system – a requirement for additional pathogen inactivation. Operation is monitored by SCADA.

4. Chlorination system – required for primary disinfection of certain viruses. Minimum chlorine contact time (CT) must be met prior to entry into the distribution system. The SCADA system monitors output from the on-line chlorine residual analyzer and will sound an alarm if necessary.

Example 3 – Secondary Disinfection:

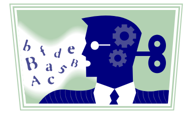
Secondary disinfection in both of the above examples is achieved by the addition of chlorine. The chlorine system is therefore a minimum CCP for secondary disinfection. The SCADA system monitors output from the on-line chlorine residual analyzer and will sound an alarm. The chlorine residual is also monitored in the distribution system.

Note that in Figure 11.5, two of the CCPs identified are recommended minimum CCPs. These are the coagulant feed system and the filtration system, both of which are necessary to meet treatment requirements and comply with the Procedure for Disinfection of Drinking Water in Ontario.

11.14 Setting Critical Control Limits

You must now establish critical control limits for your identified CCPs, including minimum CCPs. Critical control limits must be clearly expressed in your operational plan. Numerical critical control limits, such as chlorine residuals, must be indicated as a maximum (e.g. value not to exceed), minimum (e.g. value that must be exceeded), or range with clearly defined upper and lower values.

Critical control limits are typically set more stringently than regulatory requirements. This can be beneficial as deviations from a critical control limit would not result in regulatory non-compliance. The operating authority would also have time to respond and bring the process back under control.



Technical **Terms**

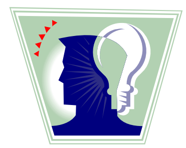
Critical control limit – the point at which a Critical Control Point response procedure is initiated.

Critical control limits can be derived from existing regulatory standards and guidelines, scientific literature, experimental studies, and consultation with experts. But you must also take into account operational capabilities to measure the variable for which the limit is established (with acceptable operational deviations).

If a critical control limit is incorrectly assigned, the production of safe water may be compromised.

Critical control limits can be identified for many different readings or observations such as:

- Temperature
- pH
- Chlorine residual
- UV dosage and intensity
- Turbidity
- Pressure
- Visual observations
- Customer complaints.



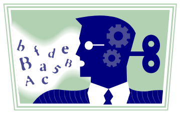
Helpful **Tips**

Critical control limits can be set at the regulatory limits but if you do so, you will not have the ability to respond and correct the situation prior to being in regulatory non-compliance.

For each CCP, your team needs to decide what critical control limits apply. Record the critical control limits for each CCP in the Risk Assessment Table. If the information is too complex for that table, create a separate procedure for that CCP and note the critical control limits there.

Remember, critical control limits only need to be assigned to critical control points.

For example, in a surface treatment system using chemically assisted filtration, the filters were identified as a CCP. On-line turbidimeters monitor filtered water turbidity, which is an important indicator of filtration efficiency. The Procedure for Disinfection of Drinking Water in Ontario requires that the filtered water turbidity be less than 0.3 NTU 95 percent of the time. In addition, O. Reg. 170/03 prescribes turbidity as an adverse result if the drinking-water system is required to provide filtration, and a result indicates that turbidity exceeds 1.0 NTU. The filtered water turbidity is trended automatically by the SCADA system to determine the 95th percentile value.



Technical **Terms**

Monitoring – includes any checks or systems that are available to detect hazards or the potential for hazards.

For example, turbidity is used to monitor the effectiveness of the chemically assisted filtration process at removing microbiological pathogens. Turbidity does not monitor the hazard of microbiological pathogens, but provides an indication that the process is operating effectively. Turbidity is known as a **surrogate parameter**.

A **control measure** – includes any processes, physical steps, or other contingencies that have been put in place to prevent or reduce a hazard before it occurs.

To establish critical control limits, the operating authority reviews the historical values for filtered water turbidity. Filtered water turbidity should be as low as possible to provide the greatest removal of microbiological pathogens such as *Giardia* and *Cryptospodium* which could be present in the source water. In addition, it is desirable to have internal control limits less than the regulatory limit to avoid exceedances. Based on the review, the following limits are programmed into the SCADA system to control the operation of each individual filter:

- 0.15 NTU – automatic filter backwash sequence is initiated
- 0.20 NTU – alarm is sounded and flow through filter is stopped. Operator investigates in accordance with the response procedure.

11.15 Monitoring CCPs

Element 8 of the DWQMS requires that procedures and/or processes to monitor the critical control points be documented in the operational plan. Now that you have identified the critical control limits for CCPs, you must document the procedures and/or the processes you have for monitoring your CCPs. Monitoring your drinking-water system is necessary to let you know if you're within those critical control limits.

Monitoring alerts you when the critical control limits have been exceeded and when measures should be activated to control the hazard. The three main purposes of monitoring are to:

- Track system performance so a critical control limit is not exceeded,
- Indicate when a loss of control and a deviation have actually occurred so response procedures can be undertaken, and
- Provide records for accountability.

Critical control limits are monitored to ensure that these limits are met. Monitoring of CCPs may be by observation or by measurement. The results should be recorded to demonstrate that monitoring is in fact taking place.

Monitoring includes any checks or systems that are available to monitor a hazardous event or a hazard. Monitoring may include process monitoring of items throughout the drinking-water system, such as:

- Raw and treated water flow
- Raw and treated water chlorine residual
- Filtered water turbidity
- Distribution system pressure
- Reservoir water levels.

Monitoring may also include:

- Visual checks
- Customer complaints monitoring

- SCADA alarm monitoring
- Security monitoring
- Daily, weekly, or monthly system checks of chemical levels, calibration, etc.

Using the Risk Assessment Table, describe the monitoring processes in place for the CCPs, or use separate procedures to describe control limits and monitoring instructions. If you have separate procedures or other related documentation, simply refer to them in the table. Examples of monitoring processes for CCPs are included with the model operational plans in Part III of this guidance document. Sample monitoring processes are described in Figure 11.6.

11.16 Establishing Procedures for Deviations from Critical Control Limits

Each CCP must have one or more documented response procedure that can be implemented to respond if a critical control limit is exceeded.

Now that you have identified your CCPs and how to monitor them, you need to establish procedures to outline actions that must be taken if monitoring indicates that the critical control limits have not been met. These procedures are necessary to control the hazardous event or minimize the risk of the production and/or distribution of unsafe drinking water, and prevent a recurrence of the problem. These are called response or corrective procedures.

Under the Response Procedure column in the Risk Assessment Table, refer to the name of the response procedure. The procedure should describe:

- Who responds,
- How the hazardous event and hazard are corrected or addressed,
- To whom the hazard occurrence is reported,
- How it is reported, and
- How the whole event should be recorded.

If the information is too complex for that table, create a separate procedure for that CCP and write monitoring instructions there. Remember to use the tips for writing a procedure outlined in Chapter 9 – Document and Records Control.

To ensure that your response procedures are effective, it is crucial to include instructions in your response procedures about investigating **why** a critical control limit was exceeded, and choosing appropriate response actions as a result. Although not directly required under the DWQMS, a good guideline for checking that your response procedures will be effective is to answer the following questions:

- Will the CCP be back under control if you follow the procedure?
- Are there instructions on how to report that the deviation has occurred?
- Are there instructions on how to identify the **cause** of the deviation?
- Are there instructions on how to eliminate the **cause** of the deviation?
- Are there instructions for preventing the deviation from happening again?
- Are there instructions for making sure that no affected water reaches the consumer?
- Are there instructions on how to record the deviation?

Figure 11.6 shows a table summarizing the critical control limits and response procedures for each identified CCP from the example Risk Assessment Table. Examples of response procedures for deviations of critical control limits are included with the model operational plans in Part III of this guidance document. Figure 11.7 shows an example of a response procedure for a situation when turbidity in treated water exceeds critical control limits.

Activity or Process Step	Description of Hazardous Event/Hazard	Critical Control Limits	Monitoring Processes and/or Procedures	Response Procedures (Detailed procedures are also required)
Source Water	Algal blooms, clogging of filters, potential for Microcystin toxin Biological/Chemical contamination of source water.	If either of the following occurs, it indicates that PAC addition should be started: • Visual observation of deteriorating water quality. • Taste and odour complaints. For chemically assisted filtration processes - see below for alum and filtered water turbidity.	Visual observations of raw water quality. Shortened filter run times. Taste and odour reviewed Monitor chemically assisted filtration processes – alum feed and filtered water turbidity. Complaints from consumers about taste and odour. Monitoring for Geosmin and Methylisoborneol (MIB).	See below for coagulant addition and filtered water turbidity. Standard Operating Procedure for PAC system.
Coagulant Addition	Coagulant interruption. Biological contamination due to ineffective chemically assisted filtration and pathogen removal.	Loss of alum flow signal - stop filtration on loss of alum flow signal, investigate feed system	Flow switch on alum line, signal from alum pump. Routine system checks.	Automatic controls shut down low lift pumps and treatment system on loss of signal. Alarm Operator investigates the problem. Responses could include: maintenance of feed system; flushing of lines; use of spare pumps; replacement of faulty parts, etc.
Filters	Filter turbidity breakthrough. Biological contamination due to ineffective chemically assisted filtration and pathogen removal.	0.15 NTU – automatic filter backwash sequence initiated 0.20 NTU – alarm sent out and flow through filter is stopped	Continuous on-line monitoring of filtered water turbidity with automatic controls. Alarm if limits exceeded.	Automatic controls stop water filtration on high filtered water turbidity. Operator investigates. Performance of other filters and the operation of the chemical feed systems are reviewed. Key raw water parameters and settled water turbidity is checked. If necessary jar tests are completed and the coagulant and polymer addition are adjusted to optimize performance.

Note: The table has been developed to describe concepts and **should not** be interpreted as being necessarily suggested or required by the Ministry.

Figure 11.6 Critical control limits and summary of response procedures for CCPs.

In the following example (Figure 11.7), settled water turbidity is monitored by SCADA in addition to filter water turbidity. **Note** that monitoring of settled water turbidity is not a regulated requirement, but has been added by the operating authority as it can provide advance warning of poor treatment performance.

Abnormal operating conditions have occurred when a **SCADA turbidity alarm limit** has been exceeded. The steps taken require some discretion on the part of the Operator and reliance on the Operator's practical experience depending on the circumstance

High Filter Turbidity
- If a SCADA alarm occurs because the filter turbidity has reached **0.20 NTU** follow the procedure outlined below**:**

High Settled Water Turbidity
- If a SCADA alarm occurs because the settled water turbidity reaches **1.0 NTU** or above follow the procedure outlined below:

Response Procedure

1. Look at the raw water turbidity to see if it is also high.
2. Increase the alum dosage.
3. The alum dosage is increased in the SCADA program. The Operator enters the setpoints manually and the adjustments take effect in approximately an hour.
4. The amount of alum dosage increase varies depending on the conditions at the time.
5. The Operator should use his or her discretion and experience to determine how much to increase the alum dosage.
6. The conditions can change within minutes due to rapid variations in raw water turbidity.
7. It takes approximately one hour for the changes to take effect throughout the system.
8. In the meantime, if the settled water turbidity increases and the turbidity at more than one filter is increasing, the Operator should add filter aid.
9. Once the filter aid is added, results should be seen in 20 to 30 minutes and the filtered water turbidity should drop (filter aid is described at the end of this section).
10. Backwash any filters with high turbidity.
11. If a filter is backwashed more filter aid must be added.
12. Filter aid spreads over an entire side of the filtration process so if you backwash one filter on that side you have to backwash them all.
13. If the filtered water turbidity increases above 0.25 NTU, see below.

Filter-Aid

- Filter-aid can be used if the Operator notices rising filter turbidity.
- Filter-aid is a type of polymer that can be added at the filters.
- The equipment present consists of a dry polymer feeder with storage capacity, hot air blower, polymer wetting disperser, a mixing tank with a portable electric mixer, a solution storage tank and transfer pumps.
- To make the filter aid, eight to 10 ounces is added to 100 gallons of water, with all 100 gallons added to one side of the filter gallery.
- Watch the filter turbidities on the SCADA screen in the control room and use experience to decide how quickly filter aid should be added.
- The filter-aid is pumped into the filter and spreads over the filter like a blanket.
- If too much filter-aid is used head loss can occur.
- If 1.5 m of head loss occurs the filter must be backwashed as required above.

When treated water turbidity reaches 0.25 NTU or above the Operator shall

1. Notify the Manager immediately.
2. Open filter to waste valves. Do not discharge filtered water to clearwells until control is regained.
3. Perform jar tests as necessary to optimize treatment.
4. If settled water turbidity is high, discharge settled water through drain until settled water is below 2.0 NTU.
5. Adjust chemical addition regime, operate single filter only in filter-to-waste mode, until filtered water turbidity is below 0.15 NTU.
6. Enter a full description of the incident and the cause in the Operator's Log Book.

Note: the above procedure is provided to illustrate concepts only, and the content **should not** be interpreted as being necessarily suggested or required by the Ministry. Response procedures will vary and are dependent on the treatment process, monitoring and controls available, and operating authority preferences.

Figure 11.7 Response procedure for turbidity exceeding critical control limits at a surface water treatment plant with chemically assisted filtration.

11.17 Keeping the Risk Assessment Current

Besides documenting the risk assessment process and outcomes in your operational plan, you must also document a method to keep the information current.

Updates to the Risk Assessment

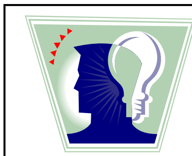
Every year you need to verify the validity of the information used in the risk assessment and how valid it is. The risk assessment must be redone every three years at a minimum.

The currency of the information and the validity of the assumptions can be verified in different ways. You may choose to have this task assigned to a single person or adopt a team approach. Here is one approach:

- Consider who you might want to contact to discuss any changes to your source water – the source water protection committee, conservation authorities, sewage treatment system managers, storm water planning departments, etc.
- See if municipal planning departments have information about significant new developments.
- Find out if regulatory changes have affected your risk assessment.
- Contact members of operations staff in the best position to know if the drinking-water system has changed in a way that could affect risk assessment. Some changes that could be important include: the addition of new treatment trains or equipment; new monitoring and/or control measures; discarding old equipment, planned maintenance and repair of key pieces of infrastructure; and long-term water level changes in your source water.

Every year you must document that this review was performed. If significant changes occur, the associated areas of the risk assessment should be updated.

Include in your procedure how you intend to redo the risk assessment every three years. For example, the procedure may simply state that redoing the task every three years is the responsibility of the Public Works Manager, who will establish and convene a risk assessment team. Note that you can also change the risk assessment methodology in future risk assessments.



Helpful **Tips**

A QMS Awareness training session will be set up later during implementation. See Chapter 21 – Completing the QMS Cycle. This will introduce all personnel to the QMS. The risk assessment, CCPs and CCP procedures are topics that you will discuss.

Risk Assessment Procedure

The procedure must describe the Risk Assessment process used so that people reviewing or updating the risk assessment can understand the process used.

Using the tips for writing a procedure outlined in Chapter 9 – Document and Records Control, write a How to Perform a Risk Assessment procedure. Be sure to cover the following items:

- How potential hazards and hazardous events are identified
- How risks are assessed
- How hazardous events are ranked according to the associated risk

- How control measures are identified
- How critical control points are identified
- How critical control limits are identified for the critical control points
- How critical control limits are monitored
- How you respond to deviations from critical control limits
- How deviations from critical control limits are reported and recorded
- How the risk assessment is verified and redone
- How equipment reliability and redundancy are determined.

For each item, remember to note who performs each task, what his or her actions are, and where and how to write down and file the results. If you followed the risk assessment approach outlined in this guidance document, you can refer to this guidance document. If you chose your own model for the Risk Assessment or CCP determination, detailed instructions will have to be provided.

11.18 Approving and Implementing

Send copies of the Risk Assessment Table and the How to Perform a Risk Assessment procedure to reviewers with specific dates included, along with the specific procedures you may have created for each CCP. The procedures should be reviewed by your Risk Assessment Team along with any other staff members, such as operators, who may have valuable input. Finalize the table, if necessary by meeting with other team members to discuss revisions.

Once the procedures have been approved, you must make sure they are followed.

If subcontractors or suppliers have any responsibilities in CCP procedures, they should be informed. In Chapter 15 – Essential Supplies and Services, various ways of communicating with subcontractors and suppliers are discussed.

11.19 Operational Plan: Risk Assessment and CCPs

The final task in this chapter is to describe what you've done for Risk Assessment in the operational plan. In the operational plan binder, create a section called Risk Assessment. Insert the How to Perform a Risk Assessment procedure, and also insert the Risk Assessment Table. Add any CCP procedures you've created.

Ready for the **Audit**

What do auditors expect to see?

- A documented risk assessment process in the operational plan that describes how everything listed in Element 7 is performed.
- Documented potential hazards and hazardous events.
- Documented risks and ranked hazardous events.
- Documented control measures for hazardous events.
- Documented critical control points and limits.
- Documented procedures and/or processes for monitoring CCPs.
- Documented response, recording and reporting procedures for CCP deviations.
- Consideration of equipment reliability and/or redundancy.
- That the relevant operating authority personnel are aware of the contents of the procedures.
- A process for review and updating all of the documents.
- That the operating authority is doing what is in the documentation.

Now that the information has been prepared, it must be kept up-to-date. Identify the most effective method for making sure changes in the system are promptly updated in the QMS documentation. Give

specific operating authority personnel the responsibility of managing updates to the documentation for the Risk Assessment and Risk Assessment Outcomes.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
Set-up of team to perform the Risk Assessment	
Identification of hazards and hazardous events	
Assessment of risks using a consistent methodology	
Ranking of hazardous events according to risk	
Identification of available control measures for each hazard	
Identification of critical control points	
Review of recommended minimum critical control points	
Establishment of critical control limits for the critical control points	
Identification of monitoring processes for critical control limits	
Establishment of procedures for deviations from critical control limits	
Establishment of procedures for reporting and recording deviations from critical control limits	
Determining if equipment reliability and redundancy have been considered	
Completion of a Risk Assessment Table	
Creation of a procedure that describes how you performed the risk assessment	
Identification of a method to verify and update the risk assessment	
Determining if the Risk Assessment Procedure covers everything in Element 7	
Review and approval of all of the documentation created in this chapter	
Release of the documentation to relevant personnel	
Ensuring that all required documentation from Elements 7 and 8 is in the operational plan	

12. Organizational Structure, Roles, Responsibilities and Authorities

12.1 Key Points in Chapter 12

- Clearly defined roles, responsibilities and authorities are an important component of an effective QMS.
- Personnel need to know their roles, responsibilities and authorities, and how they relate to those of other employees or groups.
- Responsibility for the DWQMS is shared throughout the operating authority including top management.

12.2 Translating the DWQMS

What the Standard says…

9. Organizational Structure, Roles, Responsibilities and Authorities

PLAN – The Operational Plan shall:

a) describe the organizational structure of the Operating Authority including respective roles, responsibilities and authorities,
b) delineate corporate oversight roles, responsibilities and authorities in the case where the Operating Authority operates multiple subject systems,
c) identify the person, persons or group of people within the management structure of the organization responsible for undertaking the Management Review,
d) identify the person, persons or group of people, having Top Management responsibilities required by this Standard, along with their responsibilities, and
e) identify the Owner of the subject system.

DO – The Operating Authority shall keep current the description of the organizational structure including respective roles, responsibilities and authorities, and shall communicate this information to Operating Authority personnel and the Owner.

What does it mean?

Element 9 requires that you describe the organizational structure of the operating authority including respective roles, responsibilities and authorities. If the operating authority operates more than one drinking-water system, the operational plan must also describe corporate oversight roles, responsibilities and authorities.

The person, persons, or group of people with top management responsibilities must also be identified, as must those who are responsible for undertaking Management Reviews.

The DO component of Element 9 requires that the all of the information from Element 9 is kept current and is communicated to operating authority personnel and to the owner.

12.3 Roles, Responsibilities and Authorities Overview

You must, in your operational plan, clearly define and document the roles, responsibilities and authorities of all of your personnel, as they relate to drinking water quality. Properly defined and communicated roles, responsibilities and authorities reduce the risks associated with operational activities that may be inherent in medium-to-large organizations. That way, everyone knows who does what and when, and by what authority it is done.

In your operational plan, describe the roles, responsibilities and authorities of operating authority personnel. If the operating authority operates other drinking-water systems, or if the top management that you defined in Chapter 5 includes higher levels of corporate management, the corporate oversight roles involved must also be described in the operational plan.

Identify the owner of the subject system in your operational plan. The roles, responsibilities and authorities of the owner are not required by the DWQMS to be documented in the operational plan.

Some typical roles that may be documented in the operational plan include:

Top Management

- operating authority CEO and/or Board Members for a private operating authority
- elected Municipal Officials for a municipally operated drinking-water system

Operational Management and Staff

- Water Department Superintendent
- Water Treatment Plant Foreperson
- Distribution Foreperson
- Water Treatment Plant Operator
- Distribution Operator
- Maintenance Manager

12.4 Using the Responsibilities Template

A simple method for tabulating this information is to complete the Responsibilities Table found in Appendix E. Figure 12.1 shows an example of this table. Remember to include all functional titles within your organization. Some of these may be shared roles, and some responsibilities may also be shared.

For example, if an operating authority is contracted by the owner to manage and operate more than one utility (water, electricity distribution, fibre optics network etc.) then the CEO, the vice president of finance and purchasing personnel may serve all segments of the business not just the water works.

However, their roles, responsibilities and authorities as they relate to drinking water quality still need to be described in this section of the operational plan.

Title	Responsibilities	Authorities
Operating Authority CEO	- Ensuring operations are performed according to the contract between the operating authority and the owner, and by the regulatory requirements. - Obtaining resources or infrastructure as necessary from the owner. - Providing resources or infrastructure as necessary. - Ensuring that the DWQMS is implemented and maintained, and that the operating authority is accredited. - Communicating with the owner about the drinking water system and the QMS.	- To perform listed responsibilities. - To recommend system and QMS improvements or changes, according to the operating contract. - To implement improvements or changes, according to the operating contract.
WTP Manager	- Maintains regulatory compliance. - Is the system Overall Responsible Operator. - Schedules work assignments. - Monitors water quality and demand. - Supervises operations and maintenance staff. - Maintains provincial operator licensing at plant certification level. - Organizes work-safety program. - Develops the facility budget. - Appoints QMS Representative. - Undertakes management reviews. - Reports on operations and the QMS to top management and the CEO as necessary.	- To perform listed responsibilities. - Develops, approves and directs implementation of standard safety and operating strategies/policies. - Administers the QMS. - Reports adverse water quality incidences to regulatory agencies, the owner, top management and the public.
WTP Operator	- Reports and acts upon non-conformances. - Is the designated operator-in-charge. - Follow procedures, complete forms. - Files records. - Attends training. - Receives and communicates external complaints. - Regularly communicates to the quality manager. - Carries out required operations and maintenance activities. - Maintains operator's licence.	- Performs listed responsibilities.

Figure 12.1 Example of roles, responsibilities and authorities, prepared using the responsibilities table template.

12.5 Organizational Structure

The DWQMS also requires that the operating authority describe the organizational structure. The intent of including this information is to show how the various roles within the operating authority relate to one another.

This relationship is typically structured using an organizational chart. Figure 12.2 shows an example of an organizational chart for a water treatment system. The operating authority may also simply list the positions within the organization and provide details about the reporting requirements of each position.

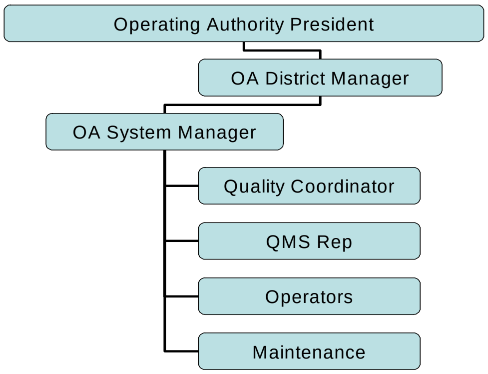


Figure 12.2 Example of an organizational chart.

Helpful **Tips**

One benefit of performing this step in your QMS implementation is determining that people with assigned responsibilities actually have the authority to properly perform those responsibilities.

Ensure that roles or titles listed in the organizational chart match those used throughout your operational plan. Use role titles that are familiar to personnel – do not create new titles.

Defining roles, responsibilities and authorities of personnel, as well as the overall organizational structure of the operating authority is another proactive method of reducing risk in the production of safe drinking water.

The owner of the subject drinking water system must also be identified.

12.6 Communicating Throughout the Operating Authority

The final step in this chapter is to communicate all roles, responsibilities and authorities, and organizational structure information to all personnel in the operating authority.

This can be done informally simply by e-mailing, posting a notice on a bulletin board or by personally discussing the information that you prepared in this chapter with all personnel.

In Chapter 21 – Completing the QMS Cycle, the task of training personnel in QMS concepts, including organizational structure, will be discussed.

Ready for the **Audit**

Throughout the audit, auditors may interview personnel for various reasons. Often, regardless of the nature of the interview, the auditor will ask the interviewee about his or her awareness of roles, responsibilities, authorities and the organizational structure, to collect proof for when these elements are evaluated.

The auditor will often ask interviewees who the QMS Representative is.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
Identification of a QMS Representative	
Completion of the Responsibilities Table, including roles, responsibilities and authorities for members of the operating authority	
Completion of the Responsibilities Table, including corporate roles, responsibilities and authorities for the operating authority if operating more than one drinking-water system	
Identification of the owner of the drinking-water system	
Charting an organizational structure for the operating authority	
Communicating information in the Responsibilities Table and in the Organizational Chart throughout the operating authority	

13. Competencies and Personnel Coverage

13.1 Key Points in Chapter 13

- Personnel must be competent in their jobs based upon appropriate education, training, skills and experience.
- You must identify and arrange for the necessary training for all personnel whose work affects drinking water quality.
- Employees need to be aware of the relevance and importance of their activities, and how they contribute to assuring quality.
- You must have procedures in place to ensure the drinking-water system is covered at all times by competent personnel.

13.2 Quiz: Test Your Understanding of Competencies and Personnel Coverage

Try this quiz now, and then again after you have finished reading this chapter.

Answer TRUE or FALSE	TRUE	FALSE
1. Maintenance of an operator's certification licence is all we need to demonstrate competency.		
2. Copies of certification licences are all we need to refer to in our operational plan.		
3. We can use our existing training matrix to show how we will meet our competency requirements.		
4. Competency means training.		
5. We can refer to our collective agreement when describing our personnel coverage.		

Answers

1. **True or False** – This question cannot be answered without identifying competency requirements for each role. Depending on the particular role in your drinking-water system, you may find that certification is the only competency requirement. However, for another system, additional competencies may be required such as training in confined spaces, WHMIS training, SCADA, and word processing. Be sure to consider **all** of the knowledge, skills and abilities that someone may draw upon to carry out his or her responsibilities. Often there are more competency requirements upon closer examination.

2. **False** – Copies of licences are records that demonstrate that a particular competency requirement has been fulfilled. The DWQMS requires that your operational plan identify what competency requirements exist for your personnel, and the activities in place to meet those requirements.

3. **True** – If you have an existing Training Matrix in place, use it. Just be sure it includes all of the competencies that you identify, and that the matrix meets the requirements detailed in this chapter.

4. **False** – Competence can be defined as the "demonstrated ability to apply knowledge and skills". In order to assess competence, you must consider an employee's education, training, skills and experience. A person may receive training and still not be competent enough to perform a certain task.

5. **True** – If your collective agreement describes how roles within the drinking-water system are filled at all times, it is a helpful supporting document for your operational plan.

13.3 Translating the DWQMS

What the Standard says…

10. Competencies

PLAN – The Operational Plan shall document:

a) competencies required for personnel performing duties directly affecting drinking water quality,
b) activities to develop and maintain competencies for personnel performing duties directly affecting drinking water quality, and
c) activities to ensure that personnel are aware of the relevance of their duties and how they affect safe drinking water.

DO – The Operating Authority shall undertake activities to:

a) meet and maintain competencies for personnel directly affecting drinking water quality and shall maintain records of these activities, and
b) ensure that personnel are aware of the relevance of their duties and how they affect safe drinking water, and shall maintain records of these activities.

11. Personnel Coverage

PLAN – The Operational Plan shall document a procedure to ensure that sufficient personnel meeting identified competencies are available for duties that directly affect drinking water quality.

DO – The Operating Authority shall implement and conform to the procedure.

What does it mean?

Element 10 of the DWQMS requires that you document in your operational plan, the knowledge, skills and abilities that personnel whose jobs affect drinking water quality must have, and the activities necessary to ensure that competency requirements are met.

The DO component of Element 10 requires that you ensure that competency requirements identified in the operational plan are met. Also, you must ensure that personnel are particularly aware of the relevance and importance of their duties and how they affect the provision of safe drinking water.

The DO component of Element 10 also requires that you maintain records of the activities undertaken to ensure that competency requirements are met.

Element 11 of the DWQMS requires that you have a procedure in place to describe how enough personnel who meet the identified competencies are available for duties that directly affect drinking water quality.

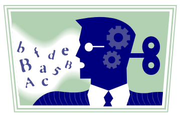
The DO component of Element 11 requires that you ensure competent personnel are available to perform their duties. Their availability should follow your coverage plans.

Your knowledgeable, skilled and capable staff is one of the most important resources to ensure drinking water safety. Identifying required competencies for staff members performing duties directly affecting drinking water quality, and making sure those competencies are met, are important functions of the QMS.

13.4 Identifying Competencies

Certification requirements are legislated for Operations staff of drinking-water systems. The DWQMS requires that you identify all competency requirements, including those that are not regulated.

A Competency Requirements Table is one method that can be used to do this. Using the roles identified in Element 10 of the DWQMS (see Chapter 12 – Organizational Structure, Roles, Responsibilities and Authorities), you can develop a list of required and desired competencies. Figure 13.1 shows an example of a Competency Requirements Table. The template for this table is available in Appendix F.



Technical **Terms**

Competence – the combination of observable and measurable knowledge, skills, and abilities which are required for a person to carry out assigned responsibilities.

One of the requirements of Element 10 of the DWQMS is that staff members are aware of the relevance of their duties and how they affect drinking water safety. You may determine that this requirement is primarily covered through your planned training activities. At a minimum, however, it is a good idea to cover this in the QMS Awareness Training Session which is discussed in Chapter 21 – Completing the QMS Cycle. The objective of this Training Session is to ensure personnel are aware of the QMS requirements that are being put into place, especially those related to their specific roles. Remember that the auditor will question staffers to determine that they are aware of the relevance of their duties.

Competency Requirements Table		
Role	**Required Competencies**	**Desired Competencies**
WTP Foreman	WTP Class III Certification Distribution Class I Certification Supervision Experience/Training System Overall Responsible Operator SCADA Training WHMIS Training Mechanical Aptitude Internal Auditor Training First Aid Training (including CPR) MS Word and Excel Training	Leadership Training Distribution Class III Certification
Distribution Foreman	Distribution Class III Certification WTP Class II Certification Supervision Experience/Training DZ Operator's Licence WHMIS Training Internal Auditor Training First Aid Training (including CPR) MS Word and Excel Training	Leadership Training Project Management Training WTP Class III Certification
WTP Operator 1	WTP Class III Certification Designated OIC SCADA Training WHMIS Training Mechanical Aptitude Internal Auditor Training First Aid Training (including CPR) MS Word and Excel Training	Distribution OIT Certification
WTP Operator 2	WTP Class II Certification Designated OIC SCADA Training WHMIS Training First Aid Training (including CPR) MS Word and Excel Training	WTP Class III Certification Distribution OIT Certification Internal Auditor Training
Distribution Operator 1	Distribution Class III Certification DZ Operator's Licence Confined Space Training CWB Certification Mechanical Aptitude First Aid Training (including CPR)	

Figure 13.1 Example of a competency requirements table.

The Table should list **all** required competencies. It may be helpful to include a reference to relevant legislation and regulations, as appropriate.

13.5 Training Matrix

Element 10 of the DWQMS requires that your operational plan identify the activities you will undertake to meet and maintain competencies you have identified.

This can be partially accomplished through the development and use of a Training Matrix. The Training Matrix can be set up to reflect the regulatory requirements for training, and then be expanded to include all other training needed to meet the required and desired competencies identified in Section 13.4.

A Training Matrix is a document that organizes employee names, roles, dates of training, duration of training, and training expiry information. An example of a Training Matrix is shown in Figure 13.2.

Developing and using a training matrix helps streamline your planning process to ensure competencies are planned for, met, and documented. Using a training matrix can also simplify the process of tracking certification training hours, a requirement under O. Reg. 128/04. If you track training and hours using a different method, refer to that method however. Note that the training described in an operational plan that has been accepted by the Ministry under the Municipal Drinking Water Licence Regime does not equate to Director Approval for training, as required under O. Reg. 128/04.

Helpful **Tips**

To streamline your planning, the Training Matrix can actually incorporate the information from the Competencies Requirements Table. This table, however, may become too complex with this much information.

For simplicity, the Training Matrix and the Competencies Requirements Table are separate here. However, you should always check, when planning training, that each employee has fulfilled his or her required competencies by comparing what is **required** from the Competencies Requirements Table against what they have **acquired**, which is recorded in the Training Matrix.

Operating Authority Training Matrix								
Employee	Role	Highest Level System Operator	Hours of Training Required	WT Certificate Expiry Date	WD/WDS Certificate Expiry Date	Training Cycle	Date Certificate Renewal Course Completed	Hours of Training Completed (in current cycle)
Jean Smith	WTP Foreman	3	120 (over three years)	Aug. 31, 2009	Mar. 31, 2009	Apr. 1, 2006-Mar. 31 2009	Aug. 12, 2007	20 CEUs 65 on the job practical
Fran Halton	Distribution Foreman	2	105 (over three years)	Sept. 30, 2008	Oct. 31, 2009	Oct. 1, 2005-Sept 30, 2008		14 CEUs 60 on the job practical

Figure 13.2 Example of a training matrix.

Create your training matrix using the template in Appendix G. If you already have a training plan in place, and choose not to use the Training Competencies table or the Training Matrix, ensure that your plan describes what competencies are required, desired, and acquired, along with training and expiry dates.

13.6 Training Methods

A description of the training methods to be used can also help to satisfy Element 10. Competency requirements can be satisfied through the use of in-house, off-site, or on-line training, attendance at seminars, presentations by subject matter experts, or on-the-job training. Training in standard operating procedures and emergency response and recovery procedures could be included as part or your in-house training. In your operational plan, describe the training methods used. You do not have to describe which training uses which method – simply list the training methods you prefer. Figure 13.3 shows an example of information that may be included in the operational plan for competencies.

Competencies

All water department foremen and treatment plant operators shall, at a minimum, attain and maintain a Class I certification as per O. Reg. 128/04. The water treatment Foreperson/Lead Hand shall maintain, at a minimum, a Class II certification.

All water department distribution employees shall, at a minimum, maintain a Class I certification as per O. Reg. 128/04 and in accordance with the classification of the works. The water distribution Foreperson/Lead Hand shall maintain, at a minimum, a Class II certification.

Additionally, annual training is provided to ensure that personnel meet or exceed minimum standards for annual training hours and continuing education hours as established in O. Reg. 128/04 to maintain operator certification for the operation of a water works.

Training effectiveness is evaluated.

Figure 13.3 Example of a competencies section from the operational plan.

13.7 Implementing Competency Requirements

Now you must implement what you have planned. That is, you must ensure that the competency requirements you have identified are met and maintained. You may need to arrange for training and compile training records. Because arranging for training can be a challenge, due to availability of staff, costs, and scheduling constraints, it is wise to start planning now.

13.8 Training Effectiveness

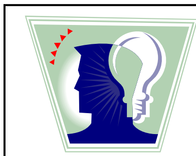
To completely close the loop of this requirement, it is good practice to evaluate the effectiveness of the training provided. This is often done by testing or through demonstration of the knowledge gained.

13.9 Personnel Coverage

The DWQMS requires that in your operational plan, you document processes and procedures to ensure coverage for the roles identified in your competencies requirements table.

Create a procedure to describe coverage, and add it to your operational plan (or refer to it). You may begin by describing how the regular shifts are structured in your water system. If you use on-call availability to ensure staff are available at all times, describe the on-call program, by including details about:

- the on-call schedule
- who sets the schedule
- the rationale for contacting personnel
- the response times for contacting personnel.



Helpful **Tips**

You may have already documented personnel coverage as part of your collective agreement.

In your operational plan you must identify how the designated Overall Responsible Operator (ORO) requirements under O. Reg. 128/04 are met. If a particular position is the primary ORO for the system this should be identified in the competencies requirements table. Only one person may be an ORO at any give time, however, within the system several individuals may perform this role. For example, there may be a different ORO identified for each shift, for weekends and holidays or during non-staffed on-call hours. If the ORO is temporarily not on-site, a description of how that person would be contacted and the response time required to arrive on-site, if required, should be included. If the primary ORO's work location or office is not normally on-site, include a description of rationale for an off-site ORO, the main work location or office, the frequency of the site visits and the response time to arrive on-site if necessary.

If the operations staff in your system is unionized, you should outline how competencies and personnel coverage are maintained during a walk-out. This could include maintaining operator certification for management staff who can assume operational duties during a strike, or having an arrangement with staff from another system to operate the plant in a strike situation.

Again, if this information is elsewhere, simply include a reference to that document. Including this coverage information in your operational plan demonstrates how the QMS ensures that any role that is important to providing safe drinking water has backup and support when needed.

If SCADA monitoring is incorporated into your coverage (e.g. auto-dialers for SCADA alarm response), describe this coverage, or refer to the document where it is already explained.

If coverage involves checks on remote locations, such as reservoirs, describe these checks.

Figure 13.4 shows an example of information that may be included in the operational plan for personnel coverage.

Ready for the **Audit**

What do auditors like to see?

The auditor will look for planning and proof of competency. Training records, attendance records, test results, enrolment acceptance, diplomas, education abstracts and certificates all constitute proof.

The auditor will also review the training matrix to see if all required competencies have been satisfied.

The auditor will review your operational plan to check that it identifies your competency requirements, and key activities undertaken to meet and maintain competencies.

The auditor will interview personnel to assess whether they are aware of the relevance of their duties and how the duties affect the provision of safe drinking water.

The auditor will review your operational plan to check that it describes how you ensure your drinking-water system is adequately overseen by competent personnel.

The auditor will look for proof of personnel coverage. This may involve reviewing operator schedules.

Personnel Coverage

The water treatment plant is staffed from Monday to Thursday from 7 a.m. until 12 a.m. and on Friday from 7 a.m. to 7 p.m. The Water Treatment foreman is the primary overall responsible operator (ORO). Back-up OROs are identified in the shift log, as required.

There is an assigned on-call water treatment plant operator during off-hours. The on-call operator conducts a physical verification of conditions at the plant once per day during weekends and statutory holidays. The normal on-call schedule for water treatment plant operators shall be from quitting time on Monday to start time the following Monday. The water treatment plant foreman establishes and maintains the on-call schedule.

At all other times, the water treatment plant is monitored by the SCADA system. The SCADA system has an auto-dialler that has been programmed to contact personnel whenever conditions warrant it. The on-call operator is the designated operator in charge and will respond to, and investigate, all alarms within 45 minutes. An ORO is available by pager when not physically at the system and is able to be on-site within 90 minutes if required.

There are daily checks at the booster station and water towers conducted by water distribution personnel. The time of the visit and the details of any related action taken are recorded in the on-site daily log.

Figure 13.4 Example of the personnel coverage section of the operational plan.

Ensure that the personnel coverage information you have described in your operational plan is in place and functioning effectively in your water system.

13.10 Enhancing Competencies

Although not specifically referenced in the DWQMS, to enhance the implementation of the competency requirements discussed in this chapter, it is recommended that you consider developing and documenting **procedures** for the identification of training needs, the provision of training, and the evaluation of training effectiveness.

Incorporation of these procedures into your QMS can greatly enhance your training programs, but is not a Standard requirement.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
Identification of required and desired competencies	
Documentation of activities to develop and maintain competencies	
Documentation of activities planned and undertaken to ensure awareness of the relevance of duties that affect safe drinking water	
Preparation of a training matrix or some other means of describing how competencies are met	
Description of training methods	
Preparation of personnel coverage procedures	

14. Communications

14.1 Key Points in Chapter 14

- A QMS that is not communicated to others is a QMS that is not implemented.
- You must have methods for communicating the QMS to the owner, all operating authority personnel, suppliers and the public.

14.2 Translating the DWQMS

What the Standard says…

12. Communications

PLAN – The Operational Plan shall document a procedure for communications that describes how the relevant aspects of the Quality Management System are communicated between Top Management and:

a) the Owner,
b) Operating Authority personnel,
c) Suppliers, and
d) the public.

DO – The Operating Authority shall implement and conform to the procedure.

What does it mean?

Element 12 requires that you have a documented procedure that describes how the QMS is communicated to others. Specifically, the procedures must address how QMS information is communicated from top management to the owner, operating authority personnel, suppliers, the public and vice versa.

A QMS that is not communicated to others is a QMS that is not implemented. Unless effectively communicated, not everyone will know about the QMS, understand its importance or follow the processes and procedures it establishes. Your QMS must be communicated by top management to the owner, personnel at the operating authority, suppliers and the public.

There are several methods that are available for communicating the QMS which are explained in this chapter.

14.3 Communicate the QMS Policy

Communication of the QMS policy to operating authority personnel is critical to the success of the QMS. The policy is the driver for the QMS and establishes firm, documented commitments that demonstrate the operating authority's assurance that quality management is important. The policy must be easily available to the public. It is also wise, although not required by the DWQMS, to send a copy of your policy to your suppliers at least once, especially essential suppliers (essential suppliers are discussed in Chapter 15 – Essential Supplies and Services).

Some of the communication methods available include:

- Discussion at staff meetings – Discuss the main commitments of the policy at staff or communication meetings.
- Schedule QMS awareness sessions to let staff know about the QMS.
- Post the policy – For example, post copies at all facilities, both operational and administrative, at sign-in desks, and at public and service entrance areas.
- Website creation – Create a link to the policy available to the public.
- Including mail stuffers – Add a printed copy of the policy to customers' water bills, or vendors' cheque payments.
- Faxing, mailing, or e-mailing suppliers. Keep a list of companies with whom you have shared the policy to avoid repeats.
- Including it in your purchase order fine print.

It is also important to consider QMS communication in the other direction – from the owner, operating authority personnel, suppliers and the public **to** top management. For example, if a consumer has comments or suggestions about the QMS or water quality in general, the operating authority should have a mechanism in place to receive those comments. The means of communication about the QMS from the owner, operating authority personnel, suppliers and the public **to** top management should be described in the Communication Procedure.

Helpful **Tips**

To write a procedure:

- Start by jotting down what is important.
- If the instructions are short, list the steps one by one.
- If the instructions are long or more complex, group the steps.
- If the reader must make decisions, use a flow chart.
- Remember to keep sentences short and precise.

In Chapter 21 – Completing the QMS Cycle, the task of training personnel in QMS concepts, including the QMS policy, will be discussed.

14.4 Owner Communication

In Element 3 of the DWQMS, you are required to obtain a written endorsement of the operational plan by the owner (covered later in Chapter 21 – Completing the QMS Cycle). By providing a current copy of the operational plan to the owner, you are ensuring that the endorsement is an informed endorsement. This is one way communication with the owner is achieved.

Both the owner and operating authority should always have a current copy of the operational plan. Summaries of changes that have been made should be included. This keeps the owner informed and meets the intent of Elements 3 and 10, and also helps ensure that the owner is meeting the provisions of section 11 - Duties of owners and operating authorities, of the SDWA.

Depending on the nature of your management structure, you may involve the owner in other areas of the QMS, such as management review, creation or endorsement of QMS policy, risk assessment, or provision of infrastructure.

Create a communication procedure, and document how owner communication is achieved. Keep the procedure simple, and remember to discuss how the QMS is communicated to and from the owner.

14.5 Operating Authority Personnel Communication

You must have a method to communicate the QMS to all operating authority personnel. Personnel includes all people working at the operating authority – regular staff, part-time and temporary staff, and summer and co-op students. This also includes non-staff working on site. Different staff members may need to know different things about the QMS. Administrative staff may only need a general level of knowledge, whereas operational staff may need to know more about the QMS, such as how to follow procedures and processes, record information related to the QMS, and how doing their jobs properly affects drinking water safety.

Information Sessions

An effective way to communicate the DWQMS to operating authority personnel is to conduct information sessions for all staff. These sessions can provide an overview of the entire QMS and, when applicable, serve as a method to introduce or roll-out procedures that are specific to all functional areas of the operating authority. Your first information session should be scheduled during the later stages of your implementation, and is described in Chapter 21 – Completing the QMS Cycle.

Many organizations use the lunch-and-learn approach for communicating QMS structure and requirements. Any method will require a record of attendees for demonstration to the auditor. Using a sign-in sheet is helpful for documenting this.

Circulate Documents

Another common method for communicating the QMS is to circulate QMS documents. Although not required under the DWQMS, a Document Transmittal Sheet can be attached to the procedures, work instructions and other QMS documentation. The Document Transmittal Sheet requests that the employee read the attached documentation (listed on the sheet), sign and return the sheet to the issuer. The transmittal sheet is now proof that the employee has received components of the documented system.

The use of the Document Transmittal Sheet is restrictive in that it does not allow for discussion of questions. It is only an acknowledgement that the requirement has been communicated. The Document Transmittal Sheet can also be used when circulating new or revised documents after the operating authority has been accredited.

Intranet or Internal Network

Any organization with an intranet or internal document network can use it to post the operational plan and all of the relevant components of the documented system (or its location if in hard copy). This allows employee access to the QMS at all times.

Ready for the **Audit**

Throughout the audit, auditors may interview operating authority personnel for various reasons. Often, regardless of the nature of the interview, the auditor will ask the interviewee about his or her awareness of roles, responsibilities, authorities and organizational structure, to collect information for when these elements are evaluated. This type of information needs to be communicated following your Communication Procedure.

The auditor will often ask interviewees who the QMS Representative is.

Bulletin Boards

Larger organizations may find it useful to produce and distribute some literature describing the QMS. Posting "Did You Know" fact sheets on bulletin boards in common areas is a typical practice.

Meetings

Meetings are an excellent opportunity to introduce and discuss QMS information. Meetings are not necessarily formal settings in the board room, but also include informal discussions at shift changes, or morning meetings.

In the Communication Procedure, add a description of how communicating the QMS to operating authority personnel is achieved.

14.6 Supplier Communication

At a minimum, your suppliers should be advised that you have developed and implemented a QMS. You are not required to supply a copy of your operational plan to the supplier. But it would be wise to provide suppliers with a copy of your QMS policy, and perhaps some sort of review of procedures that are relevant to their activities undertaken on your behalf.

For example, for suppliers delivering chemicals to a water treatment plant, at a minimum you should communicate procedures related to chemical receiving or delivery, spills response, or emergency preparedness.

There are common and simple methods for communicating the QMS to your suppliers. For local suppliers, just as with your employees, you can conduct a lunch-and-learn meeting. For suppliers outside of your region, you can include your QMS policy and an overview statement when you issue purchase orders, or when their invoices are paid.

Another method is to provide QMS information during any on-site safety briefings that you conduct for suppliers.

Ready for the **Audit**

What do auditors like to see?

The signed endorsement is proof that the QMS has been communicated to the owner. A Document Transmittal Sheet may be used for future versions.

The auditor will look for proof that the QMS has been communicated to all employees. A signed information session attendance sheet or transmittal sheet will serve that purpose, along with proof of awareness from interviews.

Producing a copy of remittance inserts or billing inserts will constitute evidence that the QMS has been brought to the attention of suppliers and consumers.

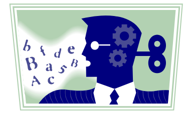
At a minimum, the QMS should be communicated to all suppliers related to your Essential Supplies and Services List, which is described in Chapter 15 – Essential Supplies and Services.

In the Communication Procedure, add a description of how communication of the QMS with suppliers is achieved.

14.7 Public Communication

One of the minimum goals for your QMS is to enhance consumer protection through the effective application and continual improvement of the QMS.

It is suggested that you include a brief explanation of the QMS (perhaps four to eight lines) and a copy of the QMS policy as a billing insert. The QMS policy can also be added as a footnote to customer bills (once existing supplies of blank invoices have been exhausted).



Technical **Terms**

The **Public** includes subject system consumers and stakeholders.

The Director's Directions, Minimum Requirements for Operational Plans specifies the requirements for public disclosure of the operational plan.

Despite the fact that the owner must make the operational plan available to the public, the owner does not have to make any part of the operational plans available for viewing by the public where the disclosure:

- could reasonably be expected to seriously threaten the safety or health of an individual;
- could prejudice significantly the competitive position or interfere significantly with the contractual or other negotiations of a person, group of persons, or organization; or
- contains trade secrets or financial, commercial, scientific or technical information that belongs to the owner or the operating authority and has monetary value or potential monetary value.

The Director's Directions should be reviewed for a complete description of requirements respecting public disclosure of operational plans.

In the Communication Procedure, add a description of how communication of the QMS with the public is achieved. Figure 14.1 shows an example of a Communication Procedure for the operating authority of a water distribution system.

14.8 Implementing Communication Procedures

The final step in this chapter is to ensure all personnel in the operating authority are aware of the Communication requirements.

This can be done informally by e-mailing, posting and discussing the information that you prepared in this chapter with all personnel.

Or, this can be done later in the implementation during the QMS Awareness sessions. In Chapter 21 – Completing the QMS Cycle, the task of training personnel in QMS concepts, including QMS communication, will be discussed.

Procedure

1. Reporting to Owner

1.1 The status of the DWQMS and its effectiveness shall be communicated to the owner during scheduled owner meetings.

2. Operating Authority Personnel

2.1 The operating authority shall ensure that all employees have attended the DWQMS Employee Orientation Session as part of the implementation process.

2.2 Employees hired after implementation of the DWQMS shall have the requirements of the DWQMS communicated to them during new employee orientation.

2.3 The operational plan, Procedures and Work Instructions shall be made available to all employees. All employees shall have electronic access to the QMS folder on the internal network. Hard copies of relevant QMS documents are also available in the Main Office.

3. Public

3.1 The operating authority has posted the QMS policy on the utility's website (insert URL). The website contains an overview of the QMS.

3.2 If desired, the operating authority may decide to provide information to the end users through the use of billing inserts.

4. Suppliers

4.1 Where appropriate, discussions, hand-outs or inserts may be provided to suppliers to communicate QMS requirements. The QMS policy is included on the reverse side of all purchase orders.

Associated Forms/Procedures/Work Instructions

- QMS policy
- Employee Orientation Procedure

Records

- Water Committee meeting minutes
- Employee training records

Figure 14.1 Sample communication procedure for the operating authority of a water distribution system.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
Documentation of a communication procedure	
The procedure describes how the relevant aspects of the QMS are communicated to the owner	
The procedure describes how the relevant aspects of the QMS are communicated to operating authority personnel	
The procedure describes how the relevant aspects of the QMS are communicated to suppliers	
The procedure describes how the relevant aspects of the QMS are communicated to the public	
Documentation of a communication procedure	

15. Essential Supplies and Services

15.1 Key Points in Chapter 15

- Supplies and services are goods and people coming in from outside of the drinking-water system, that can introduce risks to the quality and safety of your drinking water.
- You must create a list of supplies and services that are essential for the delivery of safe drinking water from a risk-based perspective, and then ensure that you have the means to ensure the quality of these essential supplies and services.
- A documented procedure must be in place to ensure the quality of supplier products and services that may affect the delivery of safe drinking water.

15.2 Translating the DWQMS

What the Standard says…

13. Essential Supplies and Services

PLAN – The Operational Plan shall:

a) identify all supplies and services essential for the delivery of safe drinking water and shall state, for each supply or service, the means to ensure its procurement, and
b) include a procedure by which the Operating Authority ensures the quality of essential supplies and services, in as much as they may affect drinking water quality.

DO – The Operating Authority shall implement and conform to the procedure.

What does it mean?

This element of the DWQMS is about managing essential supplies and services. Supplies and services, both goods and people coming in from outside of the drinking-water system, can introduce risks. Although you may not have control over their internal processes, you must be aware of which supplies and services are essential to be able to ensure that you have the means to procure those essential supplies and services at all times, and have methods in place to ensure their quality.

By documenting what quality you expect, and by continuing to assess whether or not supplies and services consistently meet your requirements after they have been selected, you help to minimize the risk to drinking water quality.

Finally, you must make sure that your expectations for essential supplies and services are met on a continuous basis.

15.3 Supplies and Services List

As a first step, compile a list of essential supplies and services. These are supplies and services that can directly affect the delivery of safe drinking water if they are not in place when needed. You can use the CCPs that you have identified in the Risk Assessment as a starting point, but the list does not need to be

based on supplies and services associated only with CCPs. Use the template for Supplies and Services found in Appendix H.

You may need to consult staff members that order or schedule supplies and services to complete this task. Figure 15.1 shows an example of some essential supplies and services associated with chlorination, documented using the template for Supplies and Services.

Essential Supply or Service	Reason
Chlorine gas supply – quality and availability	Chlorination CCP
Calibration service for chlorine scales	Chlorination CCP
Laboratory supplies	Chlorination CCP
Laboratory testing services	Chlorination CCP
O Rings and other spare parts for dosing equipment maintenance	Chlorination CCP
Diesel fuel supply for emergency generator	Emergency preparedness

Figure 15.1 Example of essential supplies and services that might be associated with chlorination.

Remember to consider all supplies or services that may be essential for the delivery of safe drinking water, even if they are not associated with a CCP. Think about a supply or service that could affect your ability to deliver safe drinking water to the consumer if it is not available, delivered incorrectly, or is not what you ordered.

For example, a small water distribution system contracts a company to do emergency pipe repairs. This service is essential for the delivery of safe drinking water, especially if there are no other companies that provide this service in the local area.

15.4 Ensuring Procurement

Element 13 also requires that for each essential supply or service that you have identified, you must state the means to ensure its procurement. Because these are essential supplies and services, the DWQMS requires that you have the means in place to ensure that these essential supplies and services can be put into place immediately, when needed, so that the delivery of safe drinking water is not affected.

Using the "Procurement" column in the Supplies and Services table that you have started (Appendix H), describe how you ensure each supply or service is made available, when required. This should include regular day-to-day operations (how you make sure supplies or services are ordered, delivered, off-loaded, and secured for everyday operation), and emergency situations (when you require an emergency or short-notice supply or service).

15.5 Requirements for Supplies and Services

Now that you have identified your essential supplies and services, the DWQMS requires that you develop and implement a procedure for those supplies and services to ensure their quality. This does not mean you need to control how outside suppliers and services manage their organizations. However, you must decide what quality requirements you have for each supply or service, and then define how you make sure those expectations are met, both during vendor selection, and on an ongoing basis.

For a supply or service to be accepted in the drinking-water system, it must meet your specified requirements. Ensuring suppliers and service providers meet quality requirements not only satisfies DWQMS requirements, but can also simplify your vendor selection process.

Quality requirements may be specified in conditions on licences or drinking water works permits (e.g. NSF approval for water treatment chemicals), or may be internal to your drinking-water system based on experience, corporate requirements, operations, or preference.

The requirements may be related to:

- The product or service
- The performance of the supplier or service provider
- The method of delivery (e.g. transport requirements)
- On-site activities (e.g. entry or off-loading procedures).

For example, a small northern municipality using alum in its water treatment operations could have its alum delivery affected by poor weather or by distribution company shortages. Due to its remote location, the municipality may have to resort to purchasing available alum from a neighbouring municipality in the event of delivery problems, or it may decide to increase its on-site inventory. The means to ensure the procurement of alum in the event of an emergency would be described, along with the means to procure alum on a regular basis.

Document your requirements for suppliers and service providers using the template for Supplies and Services in Appendix H. Consider starting with the phrase "We expect…." when completing the Quality Requirements column in the template.

For example, here are some expectations you may apply to chemical suppliers.

We expect that:

- The supplier's employees receive regular TDG, WHMIS and other workplace safety training.
- Chemicals are NSF approved.
- Delivery vehicles are equipped with the appropriate safety and environmental gear in the event of a spill.
- The supplier has a program for preventative and regular maintenance of handling equipment.
- The supplier has a history of on-time delivery.

- The supplier has a method of verifying load contents.
- The supplier can trace all products.
- The supplier includes a Certificate of Analysis for all shipments.
- Basic chemical properties are identified (e.g. pH, concentration).
- Product types are identified (e.g. catalogue number, chemical name).
- The supplier will follow approved procedures when delivering and off-loading chemicals.
- The supplier is able to respond quickly in the event of an emergency.
- If the supplier monitors and refills stock automatically, as with some carbon dioxide suppliers, the supplier is aware of the minimum quantity required to be available at all times, and the supplier maintains this quantity.

Helpful **Tips**

If the acceptable requirements vary, then specify a range of acceptable criteria. You need to be specific enough that your requirements are clear, but general enough so that you don't have to update the table every week.

Essential Supply or Service	Quality Requirements
Chlorine gas supply	▪ Chlorine gas catalogue # XX111, delivered in 200 kg tonners, NSF approved ▪ Employees receive regular TDG and WHMIS training ▪ Drivers have clean driving records ▪ Delivery vehicles equipped with the appropriate safety and environmental gear in the event of a spill ▪ History of on-time delivery ▪ Sufficient warehouse stock ▪ Documented verification of load contents provided with each shipment ▪ Product is NSF approved ▪ Certificate of Analysis provided with all shipments. Must sign in only for entry, provide documentation before offloading, and offload under operator's supervision.

Figure 15.2 Example of the requirements in place for chlorination supplies and services.

By asking these types of questions of your suppliers and service providers prior to their selection, and stating that they must continue to meet your requirements while providing you supplies and services, you are exercising control over them.

Work with the purchasing department when compiling this list. When it is complete, discuss methods for purchasing to ensure these requirements are used as selection criteria when searching for new vendors.

Ready for the **Audit**

What do auditors like to see?

- A procedure that describes what the operating authority does to ensure the quality of supplies and services.
- A controlled list of essential supplies and services.
- A list that clearly defines supply and service quality requirements – purchase orders, standing offers, contracts, etc.
- Documented means to ensure that the essential supplies and services are made available, even in the event of a short-notice request or emergency.
- A method for evaluating the suppliers ability to meet purchase requirements.

The auditor will sample and review purchasing documents to ensure that requirements are communicated.

15.6 Evaluating Testing Laboratories

In Ontario, legislation requires that laboratories performing drinking water testing be licensed, and owners and operating authorities must use these licensed labs. You should ensure that the laboratory you use is licensed. There may be other important considerations in deciding whether a laboratory meets your needs, such as the availability of rush analysis and after-hours sample reception.

If these requirements are already documented elsewhere, in a purchase agreement for example, don't rewrite them, just note where they can be found. Figure 15.2 (on the previous page) shows an example of requirements documented using the Supplies and Services template found in Appendix H.

15.7 Monitoring Supplies and Services

Explain your requirements directly to the suppliers and service providers. It is likely that some of these requirements are already known when you place orders or set up contracts. Do not assume that the suppliers and service providers know what your expectations are.

To ensure quality, you should implement a process to assess whether or not these supplies and services consistently meet requirements after they have been selected. This ongoing assessment closes the quality requirement loop. Without periodically checking whether supplies and services consistently meet requirements, you are implementing, but not maintaining, your QMS supplies and services requirements. Assign the tasks related to monitoring supplies and services to relevant personnel, and inform them of their responsibilities.

You can monitor your newer or more important essential suppliers even more closely by periodically evaluating supplier performance. For example, choose a given time period, say one year and evaluate the following:

- What percentage of the deliveries have been on-time? (target is 100 percent).
- Have there been any spills or other on-site incidences attributable to the supplier? (target is 0 percent).
- Has the product always been acceptable? (target is 100 percent).
- Has the supplier responded to all inquiries in a timely manner? (target is 100 percent).

Ensure operators or other relevant personnel in the drinking-water system are informed about your requirements for supplies and services. Monitoring requirements, along with other QMS topics, can be discussed with personnel in the first QMS Awareness training session, discussed in Chapter 21 – Completing the QMS Cycle.

Reviewing the effectiveness of your supply and service monitoring process is part of the scope of your internal audit, described in Chapter 19 – Plan for Internal Audit.

15.8 Operational Plan: Supplies and Services

Make sure that your operational plan is updated to include all of the supplies and services documents required to meet DWQMS requirements, which includes your list of supplies and services, the means to ensure procurement for each, and to ensure quality. Insert your Supplies and Services table, and your Supplies and Services procedure into your operational plan binder. If you would rather not insert documents into the binder, then just write down where those documents can be found.

Now that the information is prepared, it must be kept up-to-date. Identify the most effective method for making sure changes are promptly updated in the QMS documentation. Give specific operating authority personnel the responsibility to update the information prepared under Element 13.

15.9 Training Personnel

The final step in this chapter is to ensure all personnel in the operating authority with related duties are aware of the Supplies and Services requirements.

This can be done informally simply by e-mailing, posting or discussing the information that you prepared in this chapter with the relevant personnel.

Or, this can be performed later in the implementation during the QMS Awareness sessions. In Chapter 21 – Completing the QMS Cycle, the task of training personnel in QMS concepts, including supplies and services, will be discussed.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
Creation of a list of essential supplies and services	
Description of the means to ensure the procurement of essential supplies and services	
Documentation of quality requirements you have for essential services and supplies	
Communication of these requirements to the purchasing department, if appropriate, to be used as selection criteria for new vendors	
Communication of these requirements to relevant staff	
Communication of these requirements to suppliers and service providers	
Development of a process to monitor that supplies and services are meeting your requirements	

16. Infrastructure

16.1 Key Points in Chapter 16

- Whether you are a small operator with a single well and a limited distribution system, or a large operator serving hundreds of thousands of consumers, a robust infrastructure is necessary to meet the demand for safe drinking water.
- You must ensure that the machinery, equipment and structures used to produce and to provide safe drinking water are in place, maintained, and improved when necessary.

16.2 Translating the DWQMS

What the Standard says…

14. Review and Provision of Infrastructure

PLAN – The Operational Plan shall document a procedure for the annual review of the adequacy of the infrastructure necessary to operate and maintain the subject system.

DO – The Operating Authority shall implement and conform to the procedure and communicate the findings of the review to the Owner.

What does it mean?

Element 14 of the DWQMS requires a procedure for the annual review of drinking-water system infrastructure. The purpose is to review what infrastructure is necessary to operate and maintain the subject system, and to determine if that infrastructure is in place as needed. This review helps ensure that adequate infrastructure is available and part of the organization's plans.

The DO component of Element 14 requires that the operating authority carry out the review procedure, and report what is found to the owner. This ensures that the owner is regularly informed of infrastructure needs so that the owner can plan accordingly.

What the Standard says…

15. Infrastructure Maintenance, Rehabilitation and Renewal

PLAN – The Operational Plan shall document a summary of the Operating Authority's infrastructure maintenance, rehabilitation and renewal programs for the subject system.

DO – The Operating Authority shall:
a) keep the summary current,
b) communicate the programs to the Owner, and
c) monitor the effectiveness of the maintenance program.

What does it mean?

Continuing from Element 14, Element 15 is about documenting a summary of the maintenance, rehabilitation and renewal programs for your infrastructure. Your operational plan must include a summary of the programs you have in place to maintain, rehabilitate and renew the infrastructure of the drinking-water system. These

summaries must be updated as changes occur, and must be communicated to the owner. It is important to note that this element of the standard only applies to the operating authority's programs, and not the owner's programs.

You must also monitor the effectiveness of the maintenance program. This means that you must periodically review the maintenance program to determine how well the program is working.

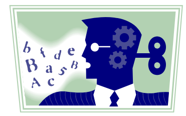
16.3 Review and Provision of Infrastructure

The operating authority must regularly examine its infrastructure, reviewing what is in place and what is needed to operate the drinking-water system safely and effectively. The parts of the infrastructure in place, including buildings, workspace, associated utilities, process equipment and supporting services are examined to determine if additional or modified infrastructure elements are needed.

Being aware of infrastructure needs and obtaining elements that you require is an inherent activity in the operation of a drinking-water system. Needs must be communicated to those who can provide them. This communication may be achieved in various ways, depending on the structure of and relationship between, the owner and the operating authority. If the drinking-water system is operated by the municipality, all communication will be within the same organization. You may already have in place the means to ensure that infrastructure adequacy is reviewed and communicated through, for example, council, budget, planning or other management meetings.

Be aware of how infrastructure review and provision is achieved within your drinking-water system and be familiar with how the use of the owner's infrastructure is arranged.

Ensure that the results of the review are communicated to the owner, and that this communication is documented.



Technical **Terms**

Infrastructure – the set of interconnected structural elements that provide the framework for supporting the operation of the drinking-water system, including buildings, workspace, process equipment, hardware and software, and supporting services, such as transport or communication.

Rehabilitation – the process of repairing or refurbishing an infrastructure element.

Renewal – the process of replacing the infrastructure element with new elements.

16.4 Operational Plan – Infrastructure Review and Provision

In your operational plan, describe the steps the operating authority takes to review the adequacy of the infrastructure. Describe who performs the review, how often it is done, how it is performed, how it is documented, and how decisions, especially fulfilling needs for additional or modified infrastructure elements, are made and effected.

For a private operating authority certain infrastructure needs may be the responsibility of the operating authority as outlined in its agreement with the owner. Some agreements may require that the owner

allocate additional resources. By communicating infrastructure requirements to the owner, you are taking steps to ensure that they are obtained or provided.

Describe how the review results are communicated to the owner, and how this communication is documented.

> **Helpful Tips**
>
> Unplanned maintenance provides a number of opportunities for improvement.
>
> By tracking or trending unplanned maintenance events, the operating authority can begin to identify weaknesses in the drinking-water system. From an equipment perspective, ongoing repairs to equipment and machinery may be an indicator that a replacement is required to reduce the risk (including financial) of catastrophic failure.
>
> Use the information from unplanned events to identify planned preventative maintenance opportunities.

16.5 Maintenance, Rehabilitation and Renewal Overview

A key part of the DWQMS, and of process control, is ensuring that the infrastructure used to produce and provide safe drinking is provided where needed, adequately maintained, and where necessary, improved. Your maintenance, rehabilitation and renewal program is at the core of this requirement. The DWQMS requires that you summarize your maintenance, rehabilitation and renewal programs in your operational plan.

Maintenance activities can be divided into two distinct categories: Planned and Unplanned.

Planned maintenance activities are scheduled or proactive activities required for maintaining or improving infrastructure elements. These activities may include equipment maintenance, main replacements, valve exercising, back-up system tests, GAC replacement and diffuser kit replacements.

Unplanned maintenance activities are reactive, and may include but not be limited to such things as addressing main breaks, pump failures, sensor failures or clogged screens.

The objective of planned maintenance is to reduce the risk of an unplanned failure of some part of the water system. Unplanned failures draw heavily on resources, may adversely affect the quality of the drinking water and can reduce both consumer and owner confidence.

In many organizations, Planned Maintenance is further subdivided into two categories: Preventative Maintenance and Predictive Maintenance. Preventative and Predictive Maintenance Programs are very effective at virtually eliminating unplanned maintenance activities. Preventative Maintenance can be easily integrated into existing operations. Predictive Maintenance requires time, knowledge and financial resources that may be beyond the scope of many operating authorities.

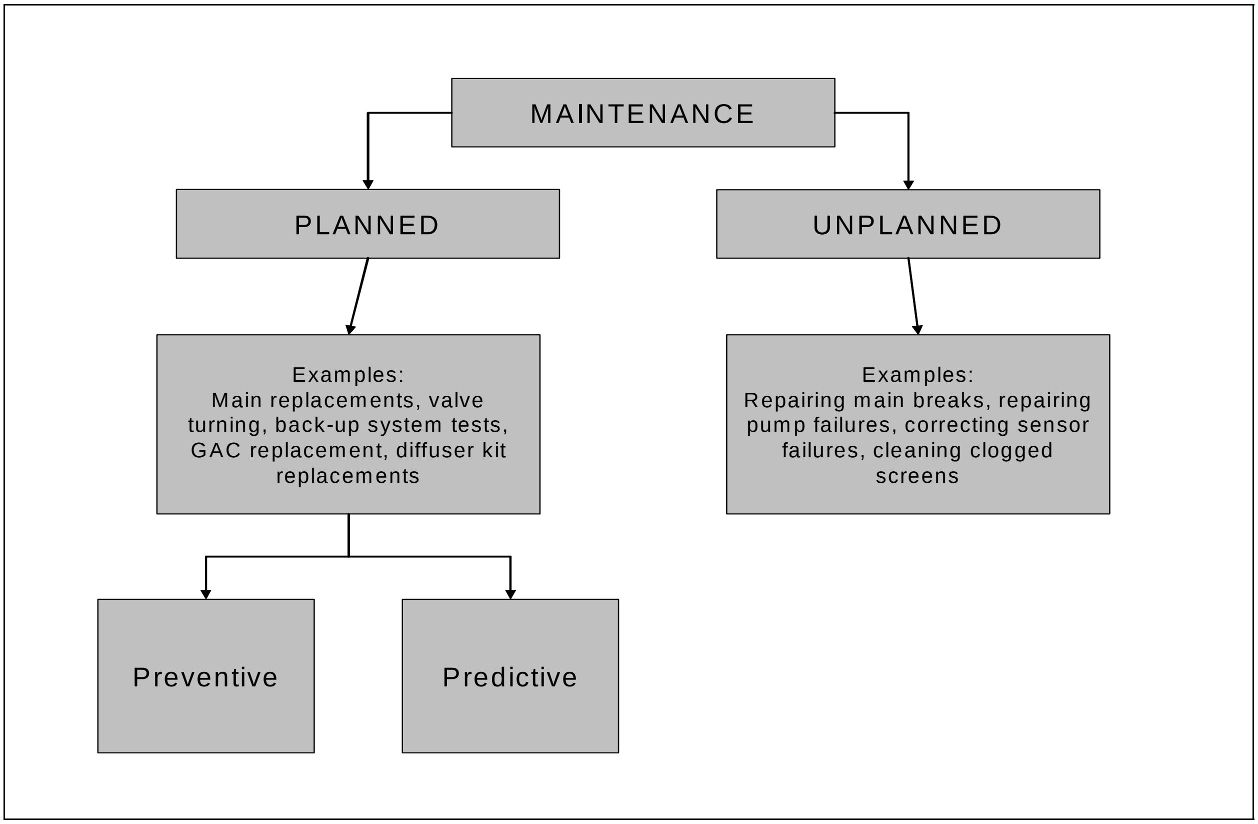


Figure 16.1 Typical maintenance program for a drinking-water system.

16.6 Establishing Maintenance, Rehabilitation and Renewal Programs

By establishing planned programs for maintenance, rehabilitation and renewal, with a focus upon preventative maintenance activities, an operating authority will see cost and time savings and an increase in owner and consumer confidence.

Although not required in the DWQMS, creation of a work-order system to collect all maintenance data, planned and unplanned, can be a very effective means of managing maintenance, rehabilitation and renewal activities. A work-order system can track time, materials, type of work and just about anything else an operating authority would need to know about its maintenance, rehabilitation and renewal activities.

For smaller systems and operating authorities consider simpler options. The system you may now have in place is a perfectly acceptable means of managing your maintenance, rehabilitation and renewal activities. One method you could try is using Microsoft Outlook or other on-line calendar systems to automatically schedule and provide reminders of maintenance activities and tasks. A paper system can be used as well, with maintenance activities for that month identified in a file. This file can be used and updated from year to year.

The data from the maintenance, rehabilitation and renewal program can also be used to enhance the value of your asset management system or process if you have one. Computerized Maintenance

Management Systems (CMMS) are excellent means of establishing and maintaining a robust maintenance, rehabilitation and renewal program.

A number of operating authorities have developed short- and long-term programs for system maintenance, rehabilitation and renewal. Some drinking-water systems have five or even 10-year rolling plans in place to address such things as main rehabilitation, upgrades and replacements. The rolling plan may also suggest that there will be a need for additional storage due to increased demand.

These plans may also take into consideration the projected needs of the water treatment plan. For example, expected population increases over the next 10 years may mean that plant processing capacity has to be increased.

These types of system maintenance requirements are usually tied to the capital budgets of the operating authority and those of the owner when appropriate.

Remember even unplanned activities should be part of your program.

16.7 Operational Plan – Maintenance, Rehabilitation and Renewal Programs

Your operational plan must summarize the maintenance, rehabilitation and renewal programs that you have in place. Use the infrastructure checklist below to help you prepare this information for the operational plan.

INFRASTRUCTURE CHECKLIST	
Activity	**Possible Considerations**
INFRASTRUCTURE MAINTENANCE Planned	Who plans maintenance?
	Who authorizes planned maintenance activities?
	How is maintenance planned? (Inspections, past maintenance, equipment manuals?)
	How is planned maintenance documented before and after the maintenance is performed?
	How is planned maintenance communicated to maintenance personnel?
	How are maintenance program needs determined and communicated?
	Is planned maintenance reviewed for trends? How?
INFRASTRUCTURE MAINTENANCE Unplanned	Who authorizes unplanned maintenance activities?
	How do you respond to unplanned maintenance needs?
	How is unplanned maintenance documented?
	Is unplanned maintenance reviewed for trends? How?
INFRASTRUCTURE REHABILITATION	Who plans rehabilitation activities and budget?
	How is rehabilitation capital authorized?
	What is considered when planning rehabilitation activities?
	How are needs for the infrastructure determined and communicated?

INFRASTRUCTURE CHECKLIST	
Activity	**Possible Considerations**
	How is projected growth considered in rehabilitation planning?
INFRASTRUCTURE RENEWAL	Who plans renewal activities and budget?
	How is renewal capital authorized?
	What is considered when planning renewal activities?
	How are needs for infrastructure renewal determined and communicated?
	How is projected growth considered in renewal planning?

Figure 16.2 An infrastructure checklist.

For example, in order to monitor the effectiveness of its maintenance program a drinking-water system decides to summarize its maintenance activities every quarter. The costs for supplies, the number of repair hours, and the number of unplanned activities are summarized for each process, based on the process flow chart from Element 6 of the DWQMS. The results are reviewed by the Supervisor and concerns are identified and discussed with the maintenance department.

The summaries and any comments from the Supervisor are filed, and also forwarded to the owner.

16.8 Monitoring the Effectiveness of the Maintenance Program

Once your maintenance program is in place, you must also have a method to monitor the effectiveness of your maintenance program. By evaluating key maintenance indicators, you can assess the effectiveness of your maintenance program. For example, indicators may include:

- The number of completed work orders or maintenance activities in a given time period.
- The number or percent of overdue planned maintenance activities.
- The response time for unplanned maintenance.
- The frequency of unplanned maintenance activities.
- The costs and cost comparisons, such as the costs of planned-to-unplanned, or costs-per-infrastructure elements.

You can define how you want to monitor your maintenance program. By monitoring such indicators, you can meet the requirements of the DWQMS, and you can experience a more efficient maintenance program.

You must implement the maintenance-monitoring program, and generate documents so that you can demonstrate that the program is in place.

16.9 Communicating the Maintenance, Rehabilitation and Renewal Programs

The summaries of the maintenance, rehabilitation and renewal programs must be communicated to the owner. Since the summaries are part of the operational plan, which is endorsed by the owner, this requirement of Element 15 can be partially satisfied when you obtain endorsement of the entire operational plan.

However, the operating authority must keep these summaries current, so be sure to forward changes to the summaries to the owner.

Results of the monitoring program for maintenance, that monitors the effectiveness of the maintenance program, must also be communicated to the owner.

Ensure that you communicate the summaries of the maintenance, rehabilitation and renewal programs to the owner, and the results of your maintenance monitoring program.

Ready for the **Audit**

Auditors will be looking for:

- A procedure for annually reviewing the adequacy of the infrastructure.
- Documents such as meeting minutes to show this review has been complete.
- Documents to show that the review results were communicated to the owner.
- Summaries of the maintenance, rehabilitation and renewal programs in the operational plan.
- Updates in the programs that have been made as a results of changes in the drinking-water system or operations.
- Documents to show the summaries were communicated to the owner.
- Documents to show that you are monitoring the effectiveness of the maintenance program.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
Development of a procedure for the review of the adequacy of the infrastructure needed to operate the drinking-water system	
Completion of the infrastructure review following the procedure	
Communication of the findings of the review to the owner	
Development of summaries of the maintenance, rehabilitation and renewal programs for the subject system and their inclusion in the operational plan	
Communication of these programs to the owner	
Documentation of owner communications	
Development of a process to keep summaries current	
Development of a process to monitor the effectiveness of the maintenance program	
Monitoring of the maintenance program for effectiveness	
Documentation of maintenance monitoring program	
Communication of the results of this monitoring to the owner	

17. Sampling, Testing and Monitoring

17.1 Key Points in Chapter 17

- Sampling, testing and monitoring enables staff in the drinking-water system to identify potential problems.
- Sampling, testing and monitoring is most important during challenging conditions to ensure that drinking water safety is maintained.
- You must know when and where to make adjustments in the drinking-water system in order to prevent situations that may result in a drinking water health risk.
- By sampling, testing and monitoring the water at various stages, the operating authority can adjust process parameters. By adjusting process parameters, the operating authority can assure the production of safe drinking water.

17.2 Quiz: Test your understanding of Sampling, Testing and Monitoring

Try this quiz now, and then again after you have finished reading this chapter.

Answer TRUE or FALSE	TRUE	FALSE
1. Sampling, testing and monitoring upstream to my drinking-water system should be included in the QMS.		
2. We need procedures which describe how we sample, test and monitor, and how we communicate the results.		
3. Since I do sampling under O. Reg. 170/03, I don't need to do this chapter.		
4. DWQMS auditors will need to see my laboratory results.		

Answers

1. **True** – If you rely on upstream sampling, testing or monitoring results to make adjustments in your process, it must be described in your QMS. It is a requirement of the DWQMS.

2. **True** – The DWQMS procedures require sampling, testing and monitoring procedures that cover how you sample, test and monitor, and how you communicate the results.

3. **False** –This chapter requires that you document the procedures that you follow to ensure that regulatory sampling is completed. The DWQMS also requires that non-regulatory sampling, testing and monitoring be documented to ensure that your process is controlled under even the most challenging conditions.

4. **True** – DWQMS auditors will ask to see lab results when reviewing sampling and monitoring. However, the auditors are not checking for regulatory compliance. They are checking to see that you performed sampling, testing and monitoring when and how your operational plan indicates, and that you used those results to maintain control in your water system.

17.3 Translating the DWQMS

What the Standard says…

16. Sampling, Testing and Monitoring

PLAN – The Operational Plan shall document:

a) a sampling, testing and monitoring procedure for process control and finished drinking water quality including requirements for sampling, testing and monitoring at the conditions most challenging to the subject system,
b) a description of any relevant sampling, testing or monitoring activities that take place upstream of the subject system, and
c) a procedure that describes how sampling, testing and monitoring results are recorded and shared between the Operating Authority and the Owner, where applicable.

DO – The Operating Authority shall implement and conform to the procedures.

17. Measurement and Recording Equipment Calibration and Maintenance

PLAN – The Operational Plan shall document a procedure for the calibration and maintenance of measurement and recording equipment.

DO – The Operating Authority shall implement and conform to the procedure.

What does it mean?

The focus of DWQMS Elements 16 and 17 is measuring your system to monitor what is happening, your level of control, and the quality of treated drinking water. Specifically, Elements 16 and 17 require that you establish and implement procedures describing how you sample, test and monitor for process control and finished drinking water quality.

The procedures must include details about the sampling, testing and monitoring that is performed on the conditions most challenging to your drinking-water system. You must also describe relevant sampling, testing and monitoring activities that you perform upstream – before water enters your drinking-water system. If this sampling, testing or monitoring is not performed by you, but provided to you, you must also describe it. You must describe how the owner and operating authority share the sampling, testing and monitoring results.

Element 17 is linked to Element 16 in this chapter since it deals with the equipment used to perform some of the sampling, testing or monitoring activities. Element 17 specifically deals with the calibration and maintenance of this measurement and recording equipment.

The DO components of Elements 16 and 17 require that you implement and conform to the sampling, testing and monitoring procedures.

17.4 Sampling, Testing and Monitoring Overview

You must know when and where to proactively adjust the operating parameters of the drinking-water system, especially those related to Critical Control Points, in order to prevent situations that may result in a drinking water health risk. Sampling, testing and monitoring activities provide information to monitor challenging raw water conditions and process performance. As well, sampling, testing and monitoring are necessary to verify finished drinking water quality.

By sampling and testing water characteristics and monitoring process parameters at various points in the drinking-water system, you further reduce the probability that something could go wrong by identifying potential problems, and by recognizing actual problems as early as possible.

This is especially crucial for CCPs. After establishing critical control limits for CCPs (see Chapter 11 – Risk Assessment and Risk Assessment Outcomes), the sampling, testing and/or monitoring of the water or processes related to that CCP can indicate if the characteristics of the water or the parameters of the process need to be adjusted in order to maintain drinking water quality.

The DWQMS does not prescribe what must be sampled, tested or monitored – drinking-water system legislation and regulations, plus conditions in licences outline sampling, testing and monitoring requirements to verify the safety of your finished water. In this chapter these requirements will be called regulatory requirements. Instead, the focus of the DWQMS is to ensure: the reliability of the sampling, testing and monitoring performed to meet legislated requirements; that adequate operational sampling, testing and monitoring are undertaken to maintain your treatment process and identify potential problems early; and that sampling, testing and monitoring activities are planned, consistently performed, documented, and communicated. The operator needs access to accurate and timely sampling, testing and monitoring information to make process adjustments to ensure drinking water safety is maintained.

Note that sampling, testing and monitoring for process control, and under conditions that are most challenging to the drinking-water system, will include operational sampling, testing and monitoring beyond what is required to comply with regulatory requirements. Sampling, testing and monitoring may be performed in response to changing conditions and to optimize treatment.

17.5 Process Control and Finished Drinking Water Quality

To begin, list all of the sampling and monitoring that takes place in your drinking-water system. It is helpful to use your Process Flow Diagrams, described in Chapter 10 – Drinking-Water System, as a guide to identify sampling and monitoring parameters. Be sure to include sampling and monitoring related to your CCPs.

Some examples of sampling, testing and monitoring that may take place in a water treatment system:

- Flow measurements at intake, in process, leaving the treatment plant
- Water depth in intake well, process units, clear wells and reservoirs
- Water temperature
- Raw, settled water, or treated water turbidity
- Raw water iron and manganese
- Water pressure in mains
- Raw, filtered water or treated water pH
- Raw, filtered water or treated water chlorine (free and total)
- Sampling for laboratory testing (organic and inorganic parameters, nitrate and nitrite, trihalomethanes, sodium, fluoride, lead).

Some examples of sampling and monitoring that may take place in a water distribution system:

- Flow measurements of water coming into the system
- Water depth in reservoirs

- Water temperature
- Water pressure in mains
- pH
- Free and total chlorine
- Sampling for laboratory testing (organic and inorganic parameters, nitrate and nitrite, trihalomethanes, sodium, fluoride, lead)

Figure 17.1 shows a table summarizing the daily water analyses performed in-house for a surface water supply to provide operational control and to verify the measurements provided by on-line measuring devices.

Raw Water	Process Water	Treated Water
Turbidity	Turbidity	Free Chlorine Residual
Temperature	Temperature	Total Chlorine Residual
pH	Free Chlorine Residual	Turbidity
Colour	Total Chlorine Residual	Temperature
Alkalinity	pH	pH
Taste and Odour compounds	Colour	Colour
	UV transmittance	Alkalinity
		Aluminium

Figure 17.1 Table of daily water analyses for a surface water treatment system.

A template for organizing your sampling and monitoring information, called the Sampling and Monitoring Table, can be found in Appendix I. When this table is completed, it can form part of a basic sampling and monitoring procedure, if your process is simple, or it can be the starting point to write more detailed procedures. Figure 17.2 shows a sample section of this table.

Sampling, Testing or Monitoring Parameter	Location	Quality Targets

Figure 17.2 Sampling, testing and monitoring table.

The sampling, testing and monitoring procedures should include, when applicable, the targets for quality or desired attributes necessary for the water at certain points within the process (CCPs and regulatory requirements at a minimum). Typically, the results would dictate whether or not adjustments need to be made to the process. Describe targets for quality or desired attributes in the "Quality Targets" column. This can be an acceptable range of results if applicable.

Exceeding any target is an undesirable process-monitoring result. The procedures must also contain the methods used to respond to situations when you exceed the targets that you have identified. Under the "Response" column, describe these response methods, or refer to documents where they are already described.

17.6 Challenging Conditions

It is important to ensure that sampling, testing and monitoring are done under conditions that challenge the system, such as after a heavy rainfall, or at the farthest ends of the distribution system, where the water has the longest residence time.

The weather can have a major influence on source water quality and quantity. Surface water and groundwater under the influence of surface water are particularly susceptible to weather conditions. The quantity, timing, and type of precipitation, changes in wind direction, snow melting, freezing and break-up can all affect water quality. Temperature changes in the raw water may also affect your disinfection and coagulation processes, process flow rates, and formation of disinfection by-products. It may be necessary to increase sampling and monitoring in response to these changing conditions to ensure processes are kept in control.

Some examples of the conditions most challenging to the drinking-water system are:

- Frazil ice in surface water
- Temperature inversions (lake water "flips")
- Extreme spring run-off causing increased turbidity in source water
- High elevation areas in water distribution systems – pressure challenges
- Following a watermain repair
- Algae bloom in source water
- Increased THM formation during warm weather
- Increased THM formation at dead ends with low flow.

After a system has operated for several years without any significant water quality issues it is possible to become complacent. Consider changing your sampling locations and times in the distribution system, to make sure that you are capturing the worst-case situations.

Document the challenging conditions in your drinking-water system, and describe what steps you take from a sampling, testing and monitoring perspective, to ensure continued process control.

Describe these conditions, or refer to related documents, under the "Challenging Conditions" column in the Sampling, Testing and Monitoring Table (see Appendix I). Of course, not every sampling, testing or monitoring parameter will have a challenging condition associated with it. Figure 17.3 shows a sample section of that table completed.

17.7 Upstream Monitoring

The DWQMS requires that relevant sampling, testing and monitoring activities upstream of the drinking-water system be documented in the operational plan. The relevance of upstream monitoring will vary for each specific system. For example:

- For a self-contained supply and distribution system in a watershed with little development, upstream monitoring may not be relevant at all.
- A stand-alone distribution system may need to make some adjustments to the process in response to both the flow and quality of the water supplied to it from an adjacent municipality. Knowing the quality of supply water is important.
- A water treatment plant using a river source may be required to adjust operations in response to an upstream contaminant spill.

It is up to you to define what is relevant. In general, sampling, testing or monitoring activities would be relevant if the results may cause you to adjust your treatment process or how you operate your system, which in turn may affect water quality. Upstream conditions may also be relevant to existing CCPs.

In your Sampling, Testing and Monitoring Table, list relevant upstream sampling and monitoring activities in your list of parameters.

17.8 Record-Keeping

The DWQMS requires that you follow a procedure that describes how sampling, testing and monitoring results are recorded. If you measure or test, then you must record the results, or there is no value to the measurement or test result. Your sampling, testing and monitoring procedures should describe where and how test results are recorded. Describe where and how test results are recorded under the "Records" column. Figure 17.3 shows a sample section of that table completed.

Remember, your records are the best way to demonstrate that your QMS has been effectively implemented.

Sampling or Monitoring Parameter	Location	Quality Targets	Response	Challenging Conditions	Records
Water depth – SCADA monitors and alarms	Intake Well	Depth greater than four meters	Investigate reason for low water levels	Intake blockage, frazil ice	Record in log book
Water temperature – daily grab sample	Intake Well	Temperature less than 5°C	Add polymer	Poor settling floc at low temperatures	Record process change in log book

Figure 17.3 Sampling, testing and monitoring table, showing a sample of sampling, testing and monitoring parameter information.

17.9 Sharing Results

The DWQMS also requires that you have a procedure that describes how sampling, testing and monitoring results are shared between the operating authority and owner, where applicable. The method of communicating these results must be included in your sampling, testing and monitoring procedures. Results of normal sampling, testing and monitoring must be communicated, along with abnormal conditions.

Helpful **Tips**

Instead of including this communication information in the sampling and monitoring table, it is permissible to expand the scope of your Communication Procedure, described in Chapter 14 – Communications, to include the reporting of results.

These include cases where a system may be reliant on the water quality supplied from another system, or may provide water to another system. The results of relevant sampling, testing and monitoring that are relevant to other connected systems need to be communicated to both the owner and the other operating authorities.

In the "Communication" column, describe what results of sampling, testing and monitoring are communicated between the operating authority and the owner.

17.10 Developing Procedures

Completion of the Sampling, Testing and Monitoring Table is meant to help you organize your sampling, testing and monitoring information. Depending on the size and complexity of your system, you will likely need to prepare your own sampling, testing and monitoring procedures using the information you have organized in the table as a starting point.

Figures 17.4 and 17.5 show an example of a Sampling, Testing and Monitoring procedure, for a large water treatment system. Due to the complexity of the sampling involved, the system would not use the Sampling and Monitoring Table in Appendix I, but could use it as a template to start the procedure-writing.

If you choose to use the completed table as the basis for the procedures required in Element 16, remember that the information in the table should describe, for each sampling or monitoring parameter:

- who has responsibilities
- what the responsibilities and activities are
- how and when the activities are performed
- how records are kept, and
- any pertinent additional information.

For upstream sampling, testing and monitoring, the DWQMS does not require procedures. The details above would not be required for the upstream sampling, testing and monitoring you listed in the Sampling, Testing and Monitoring Table.

Sampling Procedure	Procedure ID	Revision Level
Written By	**Reviewed By**	**Approved By**

Purpose
This procedure describes the sampling activities conducted by the utility to assure compliance to Ontario regulations in the production of safe drinking water.

Scope
This procedure is applicable to water treatment plant and distribution operations.

References
DWQMS Element 16
Standard Methods for the Examination of Water and Wastewater – 20th Edition

Definitions
None

Procedure

1. Samples are categorized as follows:
   - Samples for on-site analysis (Free Cl2, Turbidity, pH & Al3+)
   - Continuous SCADA sampling (Free Cl2, Turbidity & pH)
   - Microbiological samples (Bacti)
   - Chemical samples (Organics, inorganic, nitrate and nitrite, lead, trihalomethanes, sodium and fluoride)
   - Suspended solids sample (Supernatent)
   - MOE samples (DWSP)

2. Sampling activities include the raw water supply, treatment plant, distribution operations (Towers and Booster station) and downstream locations (four locations).

   2.1 At a minimum, samples are taken in compliance with all applicable Ontario Regulations.

   2.2 Physical samples are retrieved from various points in the process by plant and distribution personnel.

   2.3 The SCADA system conducts continuous sampling, however no samples are retained.

3. A list of all sampling conducted by (the operating authority) has been documented on the Master List of Sampling.

   3.1 The Master List of Sampling indicates:
   - Type of sample
   - Process sampled
   - Source of sample
   - Sample location
   - Sample frequency
   - Measurement device (Asset number)
   - Ontario Regulation (where applicable).

   3.2 Samples shall be highlighted on the Water Operations Process Map

   3.3 Measurement device calibration records are maintained at the Water Treatment Plant

Figure 17.4 Sampling, testing and monitoring procedure.

4. Physical samples shall be collected by certified operators only. Proper care shall be taken to ensure that contaminants are not introduced to the sample during collection by the operator.

   4.1 Operators shall follow the sample collection protocol as documented in Section 1 of Standard Methods for the Examination of Water and Wastewater – 20th Edition.

5. The results of all SCADA sampling shall be printed and filed by WTP personnel on a daily basis (except on weekends and statutory holidays when next working day is acceptable).

   5.1 Sampling result trends compiled by SCADA shall be printed monthly and annually and be retained at the water treatment plant. Copies may also be provided to the Water Superintendent.

6. The results of all microbiological and chemical samples (Accredited Laboratory Results) shall be retained by the (Functional Title). All other sampling records are the responsibility of the WTP Foreman and shall be retained at the WTP.

   6.1 The (Functional Title) shall ensure that all microbiological and chemical sampling records from accredited laboratories are properly filed and maintained in such a manner as to prevent damage, loss or deterioration and are readily retrievable. See the procedure for Record Control.

   6.2 The WTP Foreman shall ensure that all other sampling records other than those stated in 6.1 are properly filed and maintained in such a manner as to prevent damage, loss or deterioration and are readily retrievable. See the procedure for Record Control.

7. The results of all Bacteriological and Chemical sampling shall be provided by (the operating authority) to the (owner). The results shall be reviewed during (Descriptor) meetings.

   7.1 The (owner) will post the results on its website (Insert URL if appropriate) as public information.

<u>Associated Forms/Procedures/Work Instructions</u>

- Master List of Sampling
- Operations Process Map

<u>Records</u>

SCADA Sampling Points
Manual Sampling Records

- Accredited Laboratory Reports – Bacteriological and chemical
- Daily log sheets
- Raw Water Temperature
- Raw Water Turbidity
- Raw Water pH
- Low Lift Turbidity
- Low Lift Chlorine Residual
- Contact Chamber Chlorine Residuals
- Treated Water Aluminum Residual
- Treated Water Chlorine Residual
- Jar Test
- Floc Test
- Calibration cards

<u>Change History</u>

Revision Level	Date	Change	By
Draft	June 1, 2006		

Figure 17.5 Sampling, testing and monitoring procedure (continued).

17.11 Measurement and Recording Equipment

The DWQMS requires that you have procedures for the calibration and maintenance of measurement and recording equipment. Although it is very likely that you have this information documented in equipment manuals and preventative maintenance programs, these procedures must be part of your operational plan. Thus, you must summarize them or refer to them in your operational plan.

Figure 17.6 presents a table that can be used to summarize your measuring and recording equipment, and calibration requirements.

List the measurement and recording equipment being used in the "Devices" column. Then for each piece of equipment, describe the method of calibration, under the "Calibration Method" column. Also record the frequency of calibration. The method may be specified as a reference to the manufacturer's documentation that accompanied the equipment. There is no need to restate the calibration steps. The calibration frequency may also be derived from the manufacturer's documentation, but should be listed here.

If the calibration is performed by a certified subcontractor, ensure that a copy of the subcontractor's certificate is on file. Include that person as a critical supplier.

In the "Calibration Schedule" column, record how calibration is scheduled. Under a quality management system, it is not sufficient for the Maintenance Manager to simply remember when equipment or devices require calibration.

Under the "Calibration Results" column, describe how you document that a required calibration was performed. Not only is this information important for scheduling future calibrations, but it also serves as proof that the calibration was completed. Figure 17.6 shows a sample section of the Calibration portion of the table completed.

For example, if you use a work-order system to plan and document your maintenance activities, then the scheduling and confirmation the calibration are likely documented in your work-order system, and a reference to your work-order system in those columns would be sufficient. Others may write in scheduled calibration dates on a calendar which is used to plan work activities.

Helpful **Tips**

Do not assume anything when describing which equipment requires calibration. This is an excellent opportunity to thoroughly review which equipment requires calibration. With maintenance personnel, review the manuals for the equipment.

You may find that equipment that was assumed to **not** require calibration has a calibration requirement listed.

Ready for the **Audit**

What do auditors like to see for sampling and monitoring?

The auditor will review your sampling, testing and monitoring procedures to verify that they meet the requirements listed in Elements 16 and 17 of the DWQMS.

Auditors will review sampling, testing and monitoring records to verify that you are performing your sampling, testing and monitoring as you have stated in the procedures.

Sampling, Testing or Monitoring Parameter	Equipment	Method	Frequency	Schedule	Results
Water depth in intake well	Ultrasonics transducer	Instrument Tech uses ACME Ultrasonics equipment manual in control room	Quarterly	CMMS	CMMS, and hard copy in control room
Raw water flow meter	Magmeter	Instrument Tech uses manufacturer's manual in O&M Manual 2005 Volume 5	Quarterly	CMMS	CMMS, and hard copy in control room

Figure 17.6 Sampling, testing and monitoring table, showing an example of calibration information for sampling, testing and monitoring parameters.

Ensure that all of the equipment that requires calibration has an up-to-date record of calibration. Before you are ready for the accreditation audit, you must have all of your calibration up-to-date.

17.12 Operational Plan: Sampling, Testing and Monitoring

Make sure that your operational plan is updated to include all of the Sampling, Testing and Monitoring requirements from the DWQMS, which include the sampling, testing and monitoring procedures and the description of upstream sampling, testing and monitoring. Insert your Sampling, Testing and Monitoring Table, and any procedures that you have prepared. If you would rather not insert documents into the operational plan binder, then just write down where those documents can be found.

Now that the information is prepared, it must be kept up-to-date. Identify the most effective method for making sure changes in the system are promptly updated in the QMS documentation. Give specific operating authority personnel the responsibility for updating the information prepared under Elements 16 and 17.

17.13 Training Personnel

The final step in this chapter is to ensure all personnel in the operating authority are aware of the Sampling, Testing and Monitoring requirements.

This can be done informally by simply e-mailing, posting or discussing the information that you prepared in this chapter with all personnel.

Or, this can be performed later in the implementation during the QMS Awareness sessions. In Chapter 21 – Completing the QMS Cycle, the task of training personnel in QMS concepts, including sampling, testing and monitoring, will be discussed.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
A list of sampling, testing and monitoring parameters for your drinking-water system has been prepared	
Targets or acceptable ranges have been defined for sampling, testing and monitoring parameters	
Methods for responding when targets or acceptable ranges are exceeded have been included	
Any relevant upstream sampling, testing and monitoring activities are described	
Sampling, testing and monitoring under challenging conditions are described	
How sampling, testing and monitoring results are recorded has been described	
Measurement and recording equipment have been described	
The calibration of measurement and recording equipment, including method, frequency, planning and results has been described	
How the results are shared between the owner and the operating authority has been described	
The calibration of measurement and recording equipment is up-to-date	

18. Emergency Preparedness and Response

18.1 Key Points in Chapter 18

- An emergency is a potential situation or service interruption that may result in the loss of the ability to maintain a supply of safe drinking water to consumers.
- Emergencies may still occur in spite of our best efforts to prevent them. Proper planning for emergencies is necessary to minimize potential health risks.
- Emergency procedures should cover how to prepare for emergencies, respond, contact key parties and how to restore the system to normal operation.

18.2 Quiz: Test Your Understanding of Emergency Preparedness and Response

Try this quiz now, and then again after you have finished reading this chapter.

Answer TRUE or FALSE	TRUE	FALSE
1. Power outage can be an emergency situation.		
2. Emergency procedures can be tested using table-top exercises.		
3. Only emergency response staff needs to be trained in emergency procedures.		
4. Emergency response procedures should only be reviewed once a year.		
5. How owners and operating authorities share responsibility in emergency situations is a topic that should be covered in emergency procedures.		

Answers

1. **True** – A power outage is a situation that could cause a service interruption and subsequently cause an acute drinking water health risk. The length of time your system can operate during a power outage will vary depending on your system configuration – for systems without a back-up generator, and no elevated system storage, an emergency situation could quickly appear.

2. **True** – For many types of emergencies, staff members can meet in a conference room setting to discuss their responsibilities and how they would react to emergency scenarios. This is a cost-effective and efficient way to identify areas of overlap and confusion before conducting more demanding training or testing activities. However, testing of procedures should not be limited to only table tops exercises.

3. **False** – All staff members working within the drinking-water system need to know what to do in case of an emergency, especially if they have special emergency response roles. Others who work in the system should also be aware of emergency procedures, especially those that may be involved in the emergency or in the response to it. This includes visitors and subcontractors.

4. **False** – Emergency response procedures should be reviewed once a year, but should also be reviewed when there are significant changes in personnel, operations, equipment, and especially after an emergency or drill has occurred.

5. **True** – The DWQMS requires that procedures outline specifically how owner and operating authority responsibility is shared in an emergency.

18.3 Translating the DWQMS

What the Standard says…

18. Emergency Management

PLAN – The Operational Plan shall document a procedure to maintain a state of emergency preparedness that includes:

a) a list of potential emergency situations or service interruptions,
b) processes for emergency response and recovery,
c) emergency response training and testing requirements,
d) Owner and Operating Authority responsibilities during emergency situations,
e) references to municipal emergency planning measures as appropriate, and
f) an emergency communication protocol and an up-to-date list of emergency contacts.

DO – The Operating Authority shall implement and conform to the procedure.

What does it mean?

This element of the DWQMS is all about being prepared for emergency situations that could result in the loss of your ability to maintain the supply of safe drinking water to consumers. Emergency preparedness means identifying what could happen in your system to cause an emergency, and having processes and procedures in place to prepare for and respond to those emergencies. The DWQMS requires that your operational plan includes emergency procedures and contact information, which includes information about:

- Communication, response and recovery procedures
- Emergency Training
- Testing your procedures to make sure they make sense
- Responsibilities of personnel, owner, and operating authority
- Municipal emergency planning measures, and
- Up-to-date lists of who to call in an emergency.

The DO component of this Element requires that you implement and conform to these procedures.

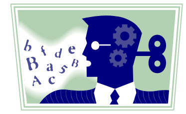
The effectiveness of response during emergencies depends on the amount of planning and training performed. Emergency management is a dynamic process. Emergency management should include training, conducting drills, testing equipment and coordinating activities with the community. If you already have emergency procedures in place, use this guidance document as a resource to assess and update your own procedures.

Emergency management is a system by which managers and staff explore system vulnerabilities, make improvements and establish procedures to follow in an emergency. Effective emergency management requires effective communication and co-ordination with the owner and other agencies and authorities such as the Medical Officer of Health and the Ministry of the Environment. In an emergency, all staff

members must know their roles and responsibilities, and how they interact with others. By establishing emergency management procedures, training personnel and testing response procedures periodically, the adverse consequences which result from emergency situations can be reduced.

It should be noted that emergency management referred to in this guidance document is in addition to and should complement the Municipal emergency plan, required by Emergency Measures Ontario.

In Appendix J, a template for Emergency Procedures can be found, that follows the topics discussed in this chapter.



Technical **Terms**

An **emergency** – a potential situation or service interruption that may result in the loss of the ability to maintain a supply of safe drinking water to consumers.

18.4 Identifying Potential Emergencies

Before jumping into procedures and contact lists, it is crucial to pay attention to the first requirement of this element – having a procedure that lists potential emergency situations or service interruptions.

There are a variety of reasons emergencies can happen including:

- Natural disasters
- Accidents
- Deliberate acts of vandalism or terrorism
- Pandemics
- System neglect or deferred maintenance.

Helpful **Tips**

Pay special attention to emergencies that may happen during off-hours, or at remote locations within the drinking-water system, as access to information, resources, or physical access may be affected by those situations.

Remember that the emergency may affect either the entire drinking-water system or only isolated sections. As well, emergency situations may arise very quickly and with little warning, as in the case of an ice storm causing a power outage, or may evolve slowly as in the case of a drought. All types of emergencies need to be considered.

Every system has its obvious emergency concerns. However, without a proper method of looking objectively at the entire system, potential risk areas may be missed. Reviewing the risk assessment process that was explained in the Chapter 11 is an excellent way of identifying potential situations or service interruptions that could result in the loss of your ability to maintain the supply of safe drinking water. Identifying potential emergencies by using the risk assessment process is especially effective because the DWQMS requires that you keep the risk assessment information up-to-date. By keeping the risk assessment up-to-date, you are also staying in touch with potential emergencies that may arise.

Ministry of the Environment inspections, corporate audits, insurance company reviews, records of past emergencies, news reports about emergencies in other systems, and risk assessments – these are all ways that potential emergency situations may be identified.

A checklist is provided in the Emergency Procedures Template, located in Appendix J to record the various potential emergencies that may occur in your drinking-water system. Figure 18.1 shows an example of this completed checklist. You may decide to include some emergency response plans, or contingency plans for emergencies that would not result in the loss of your ability to maintain the supply of safe drinking water, but this is not required as part of the DWQMS. These contingency plans can be an

excellent means to ensure staff responds appropriately to an event such as a chemical spill contained within your facility.

POTENTIAL EMERGENCIES	
Description of Emergency	**Potential Outcome**
Chemical spill in wellhead capture zone	Health risk, contamination of source water, contamination of environment, service disruption
Biological contamination of source water due to raw sewage bypass	Health risk, contamination of treated water or environment, service disruption
Drought	Water restrictions, inability to meet demand, service disruption, health risk
Construction accident in the distribution system	Loss of system pressure and water supply to area, service disruption, health risk
Fire/evacuation/explosion	Health risk, contamination of source water, contamination of treated water, contamination of environment, loss or damage to infrastructure, service disruption, employee injury
Loss of essential supplier/chemical shortage	Health risk, service disruption
Power outage	Health risk, inability to maintain system pressure and water supply, service disruption
SCADA failure	Health risk, service disruption
Pandemic	Unavailability of staff for system maintenance and operations, service disruption
Security breach/vandalism/acts of terrorism	Health risk, contamination of treated water, loss or damage to infrastructure, service disruption, employee injury
Severe storm/earthquake/tornado/flood lightning strike	Health risk, contamination of source water, contamination of treated water, contamination of environment, loss or damage to infrastructure, service disruption, employee injury

Figure 18.1 Example of potential emergencies identified.

18.5 Emergency Response and Recovery

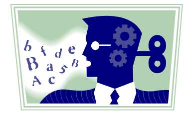
The DWQMS requires that you document and implement procedures for emergency response and recovery for the potential emergencies that you have identified. The procedures should be developed locally and should be comprehensive enough to deal with each type of emergency you've identified.

Involve the QMS Team or other key staffers, to ensure that you have covered the response thoroughly. These procedures can be independent documents, or they can be detailed instructions added to the hazards identified in your Risk Assessment. If you are writing independent procedures, remember to use the procedure format you developed in Chapter 11.

The emergency procedures should spell out how the facility will respond to emergencies. Consider the need for your procedure(s) to identify how to:

- Assess the situation
- Protect consumers, employees, visitors, equipment, vital records and other assets
- Communicate with the community, personnel, and responders
- Shut down and start up operations
- Restore operations.

Note that not all of the information above may be in a single procedure. For example, you may have separate procedures for the shut-down and start-up of operations, communications, etc.



Technical **Terms**

Emergency response – the effort to mitigate the impact of an emergency on consumers.

There are several topics that should be addressed in your emergency response and recovery procedures, which are described below:

Resources and Capabilities

Identify resources and capabilities, both internal and external, which could be needed in an emergency, including:

Personnel – fire brigade, hazardous materials response team, emergency medical services, police, municipal emergency management team, evacuation team, public information officer.

Equipment and supplies – pipe repair equipment, contractor for pipe repair, electrical repair equipment, tanker truck to haul treated water, bottled water rental equipment, fire protection and suppression equipment, communications equipment, first-aid supplies, emergency supplies, warning systems, emergency power equipment, decontamination equipment, drawings, plans and maps of the drinking-water system.

Facilities – emergency operating centre, media briefing area, shelter areas, first-aid stations, sanitation facilities.

Backup systems – arrangements with other facilities to provide for:

- Supply of treated water
- Communications
- Trained operators and other personnel
- Recovery support
- Supply of chemicals, fuel, emergency generators.

Helpful **Tips**

One way to increase response capabilities is to identify special employee skills, such as medical, engineering or communications, including foreign language capability, which might be needed in an emergency.

Whenever possible, write response procedures as a series of checklists that can be quickly accessed by managers, operators, response personnel and employees.

Responsibilities/Chain of Command

Set up clear responsibilities for managing each emergency. Specifically describe how owner and operating authority responsibility is shared during emergency situations, and identify their roles in emergency communications.

Here is an example of the chain of command that may be in place at a small drinking-water system.

Name and Title	Responsibilities During Emergency
John Smith Water System Manager	Overall management and decision making for the water system on behalf of the owner and operating authority. The lead for managing the emergency, providing information to government agencies, the public and the news media. All external communication is approved by the Water System Manager.
Mary McCarthy Clerk-Treasurer	Owner representative during the emergency. chief liaison between the operating authority and the mayor and council. Authorization of resource requests with input from council. Coordination of activities by municipal personnel.
Joan Doe Operator	In charge of performing response and recovery activities, including sampling, system operations, inspection and maintenance. Performs duties on behalf of the owner and operating authority.
Joe Brown Maintenance	In charge of performing response and recovery activities, including system operations, inspection and maintenance. Performs duties on behalf of the owner and operating authority.

Figure 18.2 Example of a chain of commend at a small drinking water system.

Communication

Establish clear responsibilities and instructions for communicating from the organization's command centre to the owner, priority consumers, the community, the authorities, (fire, police, hospital, and Medical Officer of Health, Ministry of the Environment, and other government departments) agencies, personnel, service and repair contractors, neighbouring water systems and the media.

Include instructions on how to contact specific parties, or add that information to the contact list prepared in the next section of this chapter.

Planning beforehand how those in charge will be able to talk to each other during an emergency can avoid complications later on.

Plan how media requests will be handled. A media spokesperson should be designated, and should be instructed in general media guidelines.

Sampling Requirements

Depending on the type of emergency one of the first actions you may take is to collect a sample of the source or treated water for specific analyses or to identify contaminants. Sampling may also be required to confirm that the drinking-water is safe to consume as part of emergency recovery operations. Identify when and where sampling is required in your emergency procedures. As required refer to legislated sampling protocols, or include a copy of the protocol.

Helpful Tips

Have a system in place to allow staff to rapidly access information on the system and its piping (system maps), system data (SCADA or other), chemicals used (Material Safety Data Sheets).

Ensure that access to information is possible where needed, when needed (including off-hours), and in challenging situations (during a hydro outage, for example).

Response teams

Decide who may be necessary to provide assistance during an emergency, such as piping contractors, equipment suppliers, spill response teams, fire and rescue personnel, medical facilities, trauma counselling services, and other agencies. It is helpful, in advance, to find out how much time it will take emergency services to reach your system, and plan around this response time.

Municipal Planning Measures

Part e) of the PLAN requirement of Element 18 requires that your emergency procedures specifically refer to municipal emergency planning measures, as appropriate. Assess the measures in place within the municipality and refer to them, or describe them in your own procedures.

Response Actions for Specific Events

Develop detailed response plans for each type of emergency that the system may experience. Figure 18.3 is an example of a specific emergency response procedure for a break in a transmission main.

Response Procedure – PIPELINE BREAK

Indicators of breakage:

- Distribution system reservoirs and pumping station pressures and levels are monitored continuously throughout the SCADA system.
- A large break will be indicated by a sudden and possibly large **drop in normal pressure** that will not correspond to any pump shutdown.
- Pipeline breaks will sometimes cause abnormally **high flow from discharge of pumps** causing a **high amperage draw** by the pump motor.
- **The reservoir level** will also begin to drop.

In the event of a pipeline break:

1. Operator shall shut down all pumps feeding the broken line immediately.
2. Operator shall close all remotely controlled pipeline isolation valves immediately.
3. Operator shall notify the project manager and the operations manager of the situation (see Contacts List).
4. Operator shall dispatch maintenance staff to the location.
5. Maintenance staff shall assess the situation, for impact, resources required for repair, and timing estimates.
6. Maintenance staff shall report findings to operator and operations manager.
7. If the break is on the transmission main, staff shall follow Contingency Plan Procedure.
8. If the break is not on the transmission main, Maintenance shall remain until responders from distribution system arrive, and proceed to Step 11.
9. If the break is on the transmission main, Maintenance shall initiate repair and call for subcontractor assistance as necessary.
10. Operator shall dispatch additional maintenance staff to the location if the problem pertains to the transmission main system.
11. Operations manager shall inform the municipality (see Contacts List) in the affected area of the situation regardless of whose equipment is affected (pressure losses will generate consumer complaints).
12. Operator shall record the incident in the Operator's Log Book.

Figure 18.3 Example of a spill-response procedure for a pipeline break.

Recovery

As the emergency passes and you regain control, you must prepare the system to return to its normal operating condition. Depending on the nature of the emergency, this could simply mean restoring power and disconnecting a backup generator, or it could involve collecting water samples for analysis to confirm the drinking-water is safe before a health advisory is lifted. The procedures must describe recovery methods for all of the potential emergencies identified.

Documentation

If there are any special follow-up or documentation requirements, describe this situation. Follow-up reporting may be required if the emergency involved notification of government agencies, or may be required as an internal corrective action program.

Helpful **Tips**

Create your contact list as an independent list of information. This way, as numbers and contacts change, you only have to make one edit in the contact list. If you embed the contact information right into the procedures, it makes updates more complicated.

18.6 Emergency Contacts

The DWQMS requires that you maintain an emergency communication protocol and an up-to-date list of emergency contacts. This step is essential as in an emergency you must be able to contact key parties quickly. Instructions on how to make that contact, when to contact key parties, and who has the authority or responsibility for making contacts is also important. You may have already described how to contact key parties as part of emergency response and recovery procedures, and you can then use this as part of your communication protocol. Additional information can be provided in your contact list.

Begin by creating a list of contact information for all the roles identified in the response and recovery procedures.

Contacts will vary depending upon the emergency, but in general the list should be prioritized. Each emergency procedure may outline a different contact procedure. For example, for a break in a transmission main, contacting a work crew to initiate repairs will be a high priority, whereas this would not be necessary for a power outage. Some of the contacts you may wish to include are listed below:

- System Staff
- System Owner(s)
- Police
- Hospital
- Fire Department
- Hydro Provider
- Design Engineer
- Excavation Services
- Pipe Suppliers
- Critical Equipment Suppliers
- Plumbing Services
- Fuel Suppliers
- MOE – Inspector
- MOE – Spills Action Centre
- Medical Officer of Health
- Connected Water Systems
- Radio Station(s)
- Television Station(s)
- Newspaper(s)
- Adjacent Water Systems
- Bulk Water Hauler
- Bottled Water Supplier
- Treatment Chemical Suppliers
- SCADA

Figure 18.4 shows an example of contact information that could be inserted into emergency procedures. This list also includes columns with the reason for contacting, who contacts and special instructions. The template for this contact information is in Appendix J.

Contact Name and Affiliation	Contact Information						Reason for Contacting	Who Contacts	Special Instructions
	Work phone	Work Fax	Cell	Pager	E-mail	After Hours phone			

Figure 18.4 An example of contact information for a pipeline break.

Contact information should be checked before documenting it and should include the fastest, most reliable means of contacting each party. Also ensure that a method is in place for the contact information to be regularly checked and updated, at least once a year.

18.7 Emergency Response Training

You have identified the potential situations that may lead to an acute drinking water health risk and prepared response and recovery procedures for those situations. Now for each potential emergency, the DWQMS requires that you document a procedure to maintain a state of preparedness that includes emergency response training and testing.

By testing response procedures, you ensure that they actually work, and that they are effective. You do not want to wait until an actual emergency occurs before you determine that your planned response works.

Preparing also means training. The best emergency response procedures are useless if personnel are not trained in what the procedures require them to do.

All personnel working within the drinking-water system needs to know what to do in case of an emergency, especially those with special response roles. The training expectations that you establish should be documented in your emergency response procedures. Figure 18.5 suggests who should attend emergency training, what should be covered, and the purpose of that training.

Remember to include back-up and alternate staff in the training sessions, rather than limit training to just the staff named directly in the response procedures.

Who	Emergency Topic	Purpose
All staff	General emergency awareness	**All** staff should be aware of what general emergency procedures are in place for the drinking-water system.
Staff with response roles	Specific response instructions	Staff with specific detection, response, communication or recovery responsibilities should be trained in response and recovery procedures. Be sure to cover specific responsibilities.
Visitors/ subcontractors	General emergency awareness	People who are not staff but who work in the drinking-water system may need to be aware of what to do in emergencies. This is especially true for subcontractors, visitors or suppliers on-site whose work could negatively affect the emergency situation. Decide what information people who are not staff need to know, and set up a method for getting that response information to them.

Figure 18.5 Purpose and content of training for various roles.

Training for all staff should cover:

- Individual roles and responsibilities
- Information about threats, hazards and protective actions
- Notification, warning and communications procedures
- Emergency response and recovery procedures
- Location and use of common emergency equipment, and

- Emergency shutdown procedures.

For training, be sure to record the names of the people who attended training, the dates, the name of the training class, the duration of the class, and any planned refresher training dates. You need this training information when you complete Chapter 13 – Competencies and Personnel Coverage.

18.8 Emergency Response Testing

The DWQMS requires that you outline how you test your emergency procedures. By incorporating testing of emergency procedures into the training, you satisfy two areas of the Standard at once. Be creative, and select a form of training and testing that most suits the situation within your drinking-water system. Some common forms of training and testing are described below:

Orientation and Education Sessions

These are regularly scheduled discussion sessions to provide information, answer questions and identify needs and concerns.

Table-top Exercise

Members of the emergency management group meet in a conference room to discuss their responsibilities and how they would react to emergency scenarios. This is a cost-effective and efficient way to identify areas of overlap and potential confusion before conducting more demanding training activities.

Walk-through Drill

The emergency management group and response teams actually perform their emergency response functions. This activity generally involves more people and is more thorough than a table-top exercise. Through this task, procedures and contact lists can be improved, additional training areas can be identified, and the adequacy and availability of equipment can be verified.

Functional Drill

These drills test specific functions such as emergency notifications, warning and communications procedures, and equipment readiness, although not necessarily at the same time. Personnel are asked to evaluate the systems and identify problem areas.

Ready for the **Audit**

Auditors will like to see Emergency Procedures that include:

- A thorough, sensible list of potential emergency situations and service interruptions.
- Response and recovery instructions for potential emergency conditions.
- Responsibilities and resources clearly identified.
- Training requirements for response procedures.
- Description of testing methods.
- A contact list that is up-to-date.
- Communication protocol that informs staff about how to communicate with key parties, including the listed contacts.

Auditors will also review records of emergencies, training and testing, to verify that you are maintaining preparedness as you have stated in your operational plan.

Auditors will interview employees to verify awareness of emergency requirements and will ask questions about their response to emergencies or their roles in emergency preparedness.

Helpful Tips

If you have a variety of emergency response equipment in place, it is beneficial to create a list of the items you use for response, and where they are located. With this list, staff can periodically check stocked items against the list to ensure all items are available, and to replace missing items.

Full-scale Exercise

A real-life emergency situation is simulated as closely as possible. This exercise involves company emergency response personnel, employees, management, and community response organizations.

Be sure to keep good records of this exercise, including dates, and what was changed in the QMS as a result of the test.

18.9 Being Prepared for Emergencies

Being prepared may also mean:

- Being able to detect the emergency as early as possible
- Having equipment that might be needed available, calibrated as needed, and ready.
- Having back-up plans when trained response people go on vacation.

These are not specific requirements of the DWQMS. However, they are effective processes to have in place for thorough emergency management.

Detection

For each potential emergency, you may wish to assess how you know if the emergency is occurring. If any of these detection methods require calibration, ensure the calibration is updated and recorded. Even if calibration is not required, some detection methods may need to be periodically tested, to ensure they are working properly.

If there are other detection methods available that may help staff know about a potential problem even sooner, consider implementing those methods of detection. When you have determined the detection methods, document them by describing them in the appropriate emergency procedures.

Back-up Plans

For each response procedure, you may wish to ensure that alternates are identified and documented for personnel, equipment or other resources that may not be available at all times. Consider situations such as vacation times, equipment servicing and labour disruptions, for example.

Equipment

For each potential emergency, you may wish to assess what response equipment and supplies you may require. For instance, how many days' supply of treatment chemicals do you have, and where can you access fuel for your stand-by generator during an extended power outage? Ensure the equipment is in place, available at all times (even during power outage or off-hours), and establish a method for regularly checking stock. Review other supplies you may require.

Helpful **Tips**

In addition to a yearly review, emergency procedures should also be reviewed:

- After each training drill or exercise.
- After each emergency.
- When personnel or their responsibilities change.
- When the layout or design of the facility changes.
- When policies or procedures change.

18.10 Document and Review the Emergency Procedures

The final step in this chapter is to ensure that all of the information and procedures you have put together are included in the operational plan or referred to in the operational plan. This information should be included in the operational plan, or referred to from the operational plan.

All of the information in this section of your operational plan should be regularly reviewed. One suggestion is to establish a method to have reviewers evaluate the emergency procedures which you implement, after the occurrence of an emergency – or at least once a year. This type of review is listed in the QMS Schedule in Appendix N.

Issues to consider in emergency review…	Yes/No
Can you involve all levels of management in evaluating and updating the plan?	
Are the critical control points identified in the Risk Assessment being addressed?	
Does the plan reflect lessons learned from drills and actual events?	
Have new staff members been trained?	
Do members of the emergency response team understand their respective responsibilities?	
Does the plan reflect changes in the physical layout of the drinking-water system?	
Does it reflect new facility processes?	
Have the hazards and emergency situations changed?	
Are the names, titles and telephone numbers in the plan current?	
Have community agencies and organizations been briefed on the plan? Are they involved in evaluating the plan?	

Figure 18.6 Issues to consider in an emergency review.

Describe the review process in the emergency procedures, and include the reasons that a review of the emergency procedures may take place.

18.11 Distribute the Emergency Procedures

Ensure the Emergency Procedures are available wherever they might be needed, in electronic or paper form. If choosing electronic access, ensure that the procedures can be available during a power outage.

You may wish to consider that each individual who receives a paper copy be required to sign for it and be responsible for posting subsequent changes.

Distribute the procedures to:

- Chief executives and senior managers
- Key members of the company's emergency response organization
- Company headquarters
- Community emergency response agencies (only appropriate sections – be careful of privacy issues)

Have key personnel keep a copy of the plan at their home, if they are to be contacted in off-hours during an emergency.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
Identification of potential emergency situations or service interruptions	
Documentation of emergency procedures	
Description of the responsibilities of the owner and the operating authority in the procedures	
The procedures describe communication during an emergency	
The procedures describe what sampling is required for response and recovery	
The procedures describe response teams you will utilize	
The procedures refer to municipal planning measures	
The procedures include specific response actions that must be taken	
The procedures include recovery instructions	
The procedures include your requirements for documenting the emergency, and any required follow-up reporting	
Development of an up-to-date contact lists	
Communication protocol is included	
Identification and documentation of training requirements for emergency response	
Completion of training in emergency procedures	
Planning and documentation of emergency response testing	
Review, approval and distribution of emergency procedures	

19. Plan for Internal Audit

19.1 Key Points in Chapter 19

- Internal audits are non-regulatory audits of the QMS.
- Results from internal audits add value to the organization by providing feedback about the QMS and its effectiveness.
- Internal audits are the operating authority's best method of promoting and confirming the value of the DWQMS.

19.2 Translating the DWQMS

What the Standard says…

19. Internal Audits

PLAN – The Operational Plan shall document a procedure for internal audits that:

a) evaluates conformity of the QMS with the requirements of this Standard,
b) identifies internal audit criteria, frequency, scope, methodology and record-keeping requirements,
c) considers previous internal and external audit results, and
d) describes how Quality Management System corrective actions are identified and initiated.

DO – The Operating Authority shall implement and conform to the procedure and shall ensure that internal audits are conducted at least once every twelve months.

What does it mean?

Element 19 of the DWQMS requires that you have a documented procedure for conducting internal audits of your QMS, and to verify conformity of the QMS with the requirements of the DWQMS.

Specifically, the procedure must describe what you are auditing against, how often you do so, what in your QMS is being audited, how it is audited, and what records are created. The audit procedures must also show how the planned audits are influenced by previous audit results.

When something is found that does not conform to the requirements of the DWQMS, the procedure must also describe how you identify what needs to be corrected, and how the correction is initiated.

The DO component of Element 19 requires that audits be performed as described in your operational plan, and performed in entirety at least every 12 months.

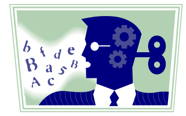
This chapter provides you with an overview of the internal audit function and its importance to your QMS. You will create an Internal Audit Procedure by following the guidance in this chapter.

Chapter 22 – Performing an Internal Audit, covers the requirements for actually completing your internal audit. You must complete Chapters 20 and 21 before you are ready to carry out your first internal audit.

19.3 Internal Auditing Overview

An internal audit is a self-evaluation of your QMS. The internal audit process ensures that the QMS has been implemented and provides proof of its effectiveness on an ongoing basis. Internal audits take a broad and deep look into how well you continue to meet your commitment to quality through the implementation of the requirements of DWQMS.

The best time to conduct your first internal audit is at least several months after you have implemented your QMS, and prior to initiating the accreditation process. This allows for the QMS to begin functioning, and for employees to become familiar with the QMS requirements.



Technical **Terms**

An **audit** – a systematic and documented verification process that involves objectively obtaining and evaluating evidence to determine whether an operating authority's QMS conforms to the requirements of this standard.

Non-conformance – the non-fulfilment of a DWQMS requirement.

Non-compliance – a failure under the *Safe Drinking Water Act, 2002*, the *Ontario Water Resources Act*, or any regulations or instruments under these Acts which are associated with drinking water.

19.4 Auditor Qualifications

The DWQMS does not prescribe what training an internal auditor requires to perform internal audits. In typical industry practices, internal auditors usually receive up to 16 hours of classroom training, plus some additional practical experience before undertaking any audits. Choosing the right people to train to do your audit can improve your results dramatically.

Good auditors can come from any part of your organization. Their work or professional status usually has little bearing on whether or not they will become effective and respected auditors. Your best auditor may be the administration person who deals with consumers on a day-to-day basis, either in person or on the phone, or is a water treatment plant operator.

Here are some valuable traits for internal auditors. They are:

- Good communicators.
- Respected by their peers and valued by their superiors.
- Positive people who support the search for solutions.
- People who understand their role and responsibilities to the organization.
- Interested in learning and are equally interested in sharing their knowledge with others who may benefit from it.
- Comfortable with themselves and with others.

If you would like more information, ISO 19011:2002 Guidelines for Quality and/or Environmental Management Systems Auditing is a published standard that outlines useful information about QMS internal audits.

19.5 Resources

Internal audits are normally conducted by operating authority personnel. However, internal auditors cannot objectively audit their own work, or audit processes for which they are responsible. It is difficult for them to remain open-minded when auditing their own work and top management cannot be certain that the audit results are accurate. This can present a challenge for you.

For example, there are many small operating authorities that only employ a few full-time staff. It is not unusual for all staff to maintain identical operator classifications and have the same responsibility and authority to manage and/or operate all aspects of the works. In cases such as these it may be difficult to assure objectivity when conducting internal audits.

Planning will be required to get internal auditors who can audit objectively set up in your system.

To address this, internal audits may be conducted by trained auditors from other sources. Other operating authorities, industry-related associations, or qualified sub-contractors – these are all viable sources for objective internal auditors.

When you have decided who will audit your QMS, create an Internal Audit Procedure using the template provided in Appendix L. Figure 19.1 shows an example of this section of the procedure.

Under the "Resources" heading, describe:

- Who will perform internal audits (list them by title, and include the name of the organization if they are from external sources).
- What training you expect them to have completed (usually completion of an internal audit training course is suitable).
- How much auditing experience you expect them to have.

Create a list of your qualified auditors. Include the list in the procedure, or to make editing easier, refer to the list in the procedure, and keep the list separate.

Helpful **Tips**

Large organizations can conduct on-site auditor training that includes role playing and mock audits to help build your auditor's confidence.

Small organizations that cannot support on-site training can take advantage of public auditor training where they share their experiences with, and learn from, participants from other utilities.

Small organizations can take a consortium approach to training and share the costs of an on-site program that would include role playing and audits of the sponsoring facility. The audits conducted by the participants can be included in the sponsoring facility's internal audit program. It may also be helpful to provide audit services for another system, while they audit yours, to ensure an unbiased review.

Volunteer to accompany the auditor during your accreditation audit. You can observe how a professional auditor conducts interviews and reviews documentation – and this may help you improve your auditing skills.

Resources

Internal audits shall only be conducted by:

- ABC Water Operating Authority personnel who have completed internal audit training.
- Lake Deep Water Works personnel who have completed internal audit training.
- Personnel from other operating authorities who have completed internal audit training and who have completed a minimum of x internal audits of their own organizations.
- Contractors who can provide objective evidence that they possess a minimum of five years of relevant auditing experience.

The QMS Representative shall maintain a list of qualified internal auditors.

Figure 19.1 Example of resources information in the internal audit procedure.

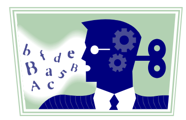
19.6 Frequency and Scope

Audits are normally planned using a 12-month rolling schedule to ensure that each requirement of the DWQMS is audited at least once over the course of a year. Some requirements or some processes may need to be addressed semi-annually or even quarterly.

The frequency and the scope that you choose will depend on your operations, scheduling, and availability of resources. It should also depend on the results of previous audits.

For example, an operating authority may find during an annual internal audit that its emergency contact list has not been updated with recent staff changes. As a result, the operating authority may audit Element 18 – Emergency Management twice in the coming year, just to check that it is kept up-to-date.

When you have selected frequency and scope, you should create a basic audit schedule. This will help you organize the resources required for the audit, and indicate what processes are to be audited in what month or quarter.



Technical **Terms**

Audit **frequency** – the number of times that an audit occurs per unit time (e.g. once per year).

Audit **scope** – a description of the extent and boundaries of the audit. Scope usually describes physical locations and organizational activities that are to be covered in the audit.

A template for an internal audit schedule is provided in Appendix K. Figure 19.2 shows an example of an internal audit schedule.

Audit Schedule			
Date of Revision:	June 2006		
Date	**Process**	**DWQMS Element**	**Auditor(s)**
October 2006	All processes in scope	All elements	JM - Lake Ontario Municipality
October 2007	All processes in scope	All elements	JM - Lake Ontario Municipality

Figure 19.2 Example of an internal audit schedule.

In the Internal Audit Procedure, describe how the frequency and scope are set for internal audits. You should mention here that the planned audit is influenced by the status and importance of the processes and areas to be audited, and previous audit results.

In the procedure, also refer to the audit schedule you have created.

19.7 Audit Preparation

Typical audit preparation consists of:

- Selection of audit team members (if experts or other auditors are required).
- Review of relevant process and QMS documentation.
- Development of an audit checklist or checklists.

Audit Team Members

In the Internal Audit Procedure, under the Audit Preparation section, describe who selects audit team members, how they are selected, and how they are notified.

Review of Information

Auditors should review the DWQMS and any other relevant information in preparation for the audit. Describe this review process in the Audit Preparation section.

Audit Checklist

It is suggested that audit checklists be created, to be used as a tool during the audit. As you conduct audits you will be developing checklists and other materials that can be used for other audits, thereby reducing your preparation time. You will also become more familiar with the QMS documentation relating to each of the processes. Hopefully, after one or two complete internal audit cycles, your preparation time will be reduced.

Helpful **Tips**

Although notification of auditors may seem formal, it is especially important if you are using external resources, such as internal auditors from other operating authorities.

Auditors usually have other responsibilities within their own organizations, and may not be available on your planned audit dates. The sooner they are notified, the better.

Failure to complete an internal audit due to poor planning of resources is not acceptable in an audit.

A template checklist is provided in Appendix M. In the Internal Audit Procedure, describe who creates the audit checklists, and where they are filed. Figure 19.3 shows an example of the Audit Preparation section of the internal audit procedure.

Audit Preparation

Internal auditors shall prepare for scheduled internal audits. Preparation shall include, at minimum:

- Creating an audit file to be used as a repository for all audit-related documentation. The audit file shall be identified by audit date and include a brief description of the area or functions being audited.
- Notifying those responsible for the function(s) to be audited of the upcoming audit at least five working days ahead of time.
- Reviewing the appropriate element(s) of the DWQMS and functionally related documentation.
- Preparing audit questions in the form of a checklist. Checklists may be retained for future audits.

Blank audit checklists shall be retained by the QMS Representative and should be made available to the internal auditor as appropriate.

QMS Representatives may review the audit checklist at their discretion.

Figure 19.3 Example of audit preparation information.

19.8 Conducting the Audit

This phase of the audit consists of having conversations (some may refer to this as conducting interviews) with process owners and reviewing process results (records) to confirm the status of the requirements. The DWQMS requires that your procedures describe how you will conduct the audit (methodology).

In your Internal Audit Procedure, under Conducting the Audit, describe how you will use your checklists to collect and record information. Also describe how non-conformance is identified and documented.

Some organizations prefer to have opening or closing meetings for internal audits as a means to introduce the audit team, and establish the importance of the audit. If you will have opening or closing meetings, describe this in your Internal Audit Procedure.

19.9 Reporting

This phase of the audit consists of reporting audit findings and communicating about the report.

Reporting the audit results to management is typically done twice – once verbally in a closing meeting (if you are conducting closing meetings), and then in a written audit report.

Closing meeting participants should also include all those who participated in the audit. During the meeting, which should only take about 30 minutes, the auditor outlines the positive aspects of the audit and any non-conformance that was discovered. The same information is then provided in a detailed written report.

Decide what information you will include in the audit report, to whom the report will be issued, and who will prepare the report. Describe this in your Internal Audit Procedure, under Audit Report and Follow-Up.

19.10 Follow-Up

The audit is not closed until all non-conformances identified in the closing meeting have been corrected and that the corrective action taken has been verified as being effective at eliminating the root cause of the non-conformance.

Your audit procedure should describe how corrective actions will be documented, initiated, and followed up, or referred to a procedure that describes how you will correct QMS non-conformances. Chapter 24 – Maintenance and Continual Improvement of the QMS, discusses this in more detail.

The procedure should also describe what is required for the audit to be considered closed. It is wise to include target timeframes for response to non-conformances in the procedure. Figure 19.4 shows an example of the Audit Report and Follow-Up section of an Internal Audit Procedure.

Audit Report and Follow-Up

- The auditor shall provide a written report of the findings to the manager of the functional area audited within seven working days of the audit.
- The audit report should be in narrative form complete with any Corrective Action Reports (if not provided during the closing meeting). A copy of the audit report shall also be provided to the QMS Representative (if he or she is not the manager of the functional area).
- A copy of the audit report, checklist(s), and Corrective Action Reports shall be filed in the audit file maintained by the QMS Representative.
- The Manager assigned in the Corrective Action Report is responsible for the correction of any non-conformances. The Manager shall document corrective actions in the Corrective Action Report.
- The audit shall be considered closed once all corrective actions have been verified as being effective.

Figure 19.4 Example of audit report and follow-up information in the internal audit procedure.

Ready for the **Audit**

What do auditors like to see?

Auditors will expect to see your Internal Audit Procedure that covers the frequency, scope, method, and records for internal audits. The auditor will also expect to review your tools for auditing that are used in the procedure, such as auditing checklists or an audit schedule, to verify that they meet DWQMS requirements.

The auditor will also request to see your audit schedule, to demonstrate that you are planning audits according to your defined frequency. The auditor will verify that the schedule, or your instructions for creating the schedule, takes into consideration the status and importance of the processes and areas to be audited, and the results of previous audits.

19.11 Procedure Approval

When you have finished preparing your new Internal Audit Procedure, arrange for its review and approval. Provide an approved copy to the internal auditors, if they have not already seen it.

19.12 Operational Plan: Internal Audit

Make sure that your operational plan is updated to include the Internal Audit Procedure. Insert your Internal Audit Procedure into the operational plan binder, or if you would rather not insert documents into the binder, just write down where those documents can be found.

Now that the information is prepared, it must be kept up-to-date. Identify the most effective method for making sure that changes in the system are promptly updated in the QMS documentation. Give specific operating authority personnel the responsibility to update the information prepared under Element 19.

19.13 Training Personnel

The final step in this chapter is to ensure that all relevant personnel in the operating authority are aware of the Internal Auditing Procedure requirements.

This can be done informally simply by e-mailing, posting or discussing the information that you prepared in this chapter with all personnel.

Or, this can be performed later in the implementation during the QMS Awareness sessions. In Chapter 21 – Completing the QMS Cycle, the task of training personnel in QMS concepts, including internal auditing, will be discussed.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
An Internal Audit Procedure has been documented and approved	
The procedure includes a description of who will perform internal audits, including their training and experience requirements	
The procedure includes a description of audit frequency and scope, and how it is planned	
An audit schedule has been created	
The procedure includes a description of audit team member selection in preparation for an audit	
The procedure includes a description of how audit team members review information in preparation for an audit	
The procedure includes a description of how audit checklists are prepared	
The procedure includes a description of how the audit is conducted	
The procedure includes a description of how the audit is reported	
The procedure includes a description of how the audit is followed up	

20. Plan for Management Review

20.1 Key Points in Chapter 20

- Top management from the operating authority should review the QMS.
- Management reviews need not be performed directly by top management, particularly for large operating authorities which manage many different systems.
- Management reviews ensure top management stay involved in the QMS, and provide direction for continual improvement.

20.2 Translating the DWQMS

What the Standard says…

20. Management Review

PLAN – The Operational Plan shall document a procedure for management review that evaluates the continuing suitability, adequacy and effectiveness of the Quality Management System and that includes consideration of:

a) incidents of regulatory non-compliance,
b) incidents of adverse drinking-water tests,
c) deviations from critical control point limits and response actions,
d) the efficacy of the risk assessment process,
e) internal and third-party audit results,
f) results of emergency response testing,
g) operational performance,
h) raw water supply and drinking water quality trends,
i) follow-up on action items from previous management reviews,
j) the status of management action items identified between reviews,
k) changes that could affect the Quality Management System,
l) consumer feedback,
m) the resources needed to maintain the Quality Management System,
n) the results of the infrastructure review,
o) Operational Plan currency, content and updates, and
p) staff suggestions.

DO – Top Management shall implement and conform to the procedure and shall:

a) ensure that a management review is conducted at least once every twelve months,
b) consider the results of the management review and identify deficiencies and action items to address the deficiencies,
c) provide a record of any decisions and action items related to the management review including the personnel responsible for delivering the action items and the proposed timelines for their implementation, and
d) report the results of the management review, the identified deficiencies, decisions and action items to the Owner.

What does it mean?

The PLAN component of Element 20 requires you to have a procedure for an annual management review, and lists the topics which the management review must cover. A review of these topics, which include compliance, consumer, performance, and audit information, involves management in the QMS cycle.

The DO component of Element 20 requires implementation of and conformance to the procedure. It specifies a maximum 12-month frequency for reviews, and requires that top management ensure the review is performed, identifies deficiencies, and reports the results to the owner. Remember that as a requirement of Element 9 – Organizational Structure, Roles, Responsibilities and Authorities, the person, persons or group of people within the management structure of the organization responsible for undertaking management reviews must be identified.

This chapter provides you with an overview of the management review function and its importance to your QMS. You will create a management review procedure by following the guidance in this chapter.

Chapter 23 – Performing a Management Review, covers the requirements for actually completing your management review. You must complete Chapters 21 and 22 before you are ready to carry out your first management review.

20.3 Management Review Overview

Management review is a process where a higher level of managers in the operating authority considers various indicators within the QMS. Top management is responsible for ensuring the review is performed. Delegation of this responsibility may be appropriate for large operating authorities with many drinking water systems, but if at all practical, members of top management should perform the review themselves. When effectively implemented, the management review provides top management with appropriate and sufficient data to make decisions about the QMS, and record decisions or action items to prompt changes and improvements in the QMS.

These data serve not only as an indicator of QMS performance, but also as input for the decisions that top management needs to consider making for ongoing maintenance and continual improvement of the QMS.

The best time to conduct your first management review is at least several months after you have implemented your QMS, prior to initiating the accreditation process, and after you have completed your first internal audit. This allows the QMS to begin functioning, and for employees to become familiar with the QMS requirements. Chapter 23 – Performing a Management Review, covers the requirements for actually completing your management review.

20.4 Assign Management Reviewers

Begin by creating a management review procedure, using the format for procedures that you have established.

Typically, the management review is conducted by top management, or other higher levels of management within the operating authority – you define the reviewers (Element 9 – Organizational Structure, Roles, Responsibilities and Authorities). You may wish to include other participants who can provide input and insight from an operational perspective that may not be known to top management.

The DO component in Element 20 requires that top management is responsible for ensuring the review is conducted and conforming to the procedure.

It is always a good idea to include the QMS Representative in the management review. One of the responsibilities of the QMS Representative, from Element 4 of the DWQMS is to report to top management on the performance of the QMS and any need for improvement. Having the QMS Representative participate in the management review process is one way of satisfying this responsibility. In the procedure, define who will be expected to participate in the management review activities.

20.5 Frequency

The management review must be conducted at least every 12 months. Depending on the business culture of your operations, and the amount of material to be covered, you may schedule more frequent management reviews (e.g. quarterly) in order to assess QMS indicators within a more relevant time frame.

Remember, looking at data that could be up to one year-old may not be as valuable as looking at data more frequently. Also, a more frequent series of management reviews throughout the year may provide a more realistic view of the condition of your system.

In the management review procedure, define the frequency of management reviews, and how they will be scheduled.

20.6 What to Consider in Management Reviews

The management review process looks at certain indicators that show how well you have implemented your QMS, and how effectively it is operating.

Management reviewers are required to consider:

- Incidents of regulatory non-compliance,
- Incidents of adverse drinking-water tests,
- Deviations from critical control point limits and response actions,
- The efficacy of the risk assessment process,
- Internal and third-party audit results,
- Results of emergency response testing,
- Operational performance,
- Raw water supply and drinking water quality trends,
- Follow-up on action items from previous management reviews,
- The status of management action items identified between reviews,
- Changes that could affect the QMS,
- Consumer feedback,
- The resources needed to maintain the QMS,
- The results of the infrastructure review,
- Operational plan currency, content and updates, and
- Staff suggestions.

Other data may be added if you feel it would be valuable for the management review process.

You should have a process in place for collecting and summarizing the data that supports the requirements for management review as not all of this information will be collected as part of the QMS. Assigning this responsibility to the QMS Representative is common, but not necessary.

In the management review procedure, list the information that will be provided to the management reviewers. Describe how this information will be collected, summarized and provided. It is wise to also stipulate a time period within which the information will be provided to the management reviewers. There is a lot of material to review, and sufficient time should be allowed to review it.

Ready for the **Audit**

What do auditors like to see?

Auditors will expect to see a management review procedure that shows how you ensure that relevant items are considered during the review.

20.7 Agenda

As part of your planning for management review, it is worthwhile to create an agenda for the meeting. Although not required under the DWQMS, this will help direct the meeting, and keep discussion on track. There is a considerable amount of information to review, discuss, and make decisions upon, making time-management tools very important. The agenda can be part of the procedure or a separate document.

20.8 Deficiencies, Decisions and Action Items

During the management review, reviewers discuss the items listed in Section 20.6. Discussions around resource needs, progress, pitfalls, impending business or operational changes often occur, and should be documented in the minutes. Concerns that are identified should be communicated to top management, if top management is not directly involved in the management review. Top management is then responsible for considering these results, and identifying deficiencies in the QMS.

Top management must also identify action items to address the deficiencies. This can be done at the same management review meeting, if top management is part of the management review, or at an alternate meeting, or through e-mails or phone calls. The deficiencies and action items must be documented. Personnel responsible and timelines for delivering action items must also be identified by top management, and recorded. All of this information must then be communicated to the owner.

All of these activities related to deficiencies, decisions and action items, and communication to the owner, are not performed at this stage, when planning for management review. The DWQMS does not require that you plan these activities, or document the process for these activities in the management review procedure. However, to ensure management reviews are performed consistently, and that the required documentation is in place after a management review, it is wise, in the management review procedure to outline the process for identifying deficiencies, making decisions and identifying action items, and the way to communicate them to the owner.

20.9 Procedure Approval

When you have completed preparing your management review procedure, arrange for its review and approval. An example of a management review procedure is shown in Figure 20.1. This operating authority is responsible for three drinking-water systems, and it has been decided that top management will participate directly in management reviews.

Management Review Procedure

1. Frequency

1.1 Top management shall review the QMS on an annual basis to assess and ensure the continuing suitability, adequacy and effectiveness of the QMS.

1.2 Management review(s) shall be included in the internal audit schedule.

2. Reviewers

2.1 Management review participants shall include:

- Operating Authority CEO
- Operating Authority Vice President(s)
- Operating Authority Superintendent
- Water Plant Operations Foreperson
- Water Distribution Operations Foreperson
- QMS Representative

2.2 The CEO may include other personnel at his or her discretion

2.3 Attendees shall be notified of the management review meeting by e-mail.

3. Process

3.1 The QMS Representative shall provide a summary of the following information in a suitable format to the management review meeting attendees at least seven days prior to the meeting:

- Incidents of regulatory non-compliance,
- Incidents of adverse drinking-water tests,
- Deviations from critical control-point limits and response actions,
- The efficacy of the risk assessment process,
- Internal and third-party audit results,
- Results of emergency response testing,
- Operational performance,
- Raw water supply and drinking water quality trends,
- Follow-up on action items from previous management reviews,
- The status of management action items identified between reviews,
- Changes that could affect the QMS,
- Consumer feedback,
- The resources needed to maintain the QMS,
- The results of the infrastructure review,
- Operational plan currency, content and updates, and
- Staff suggestions.

3.2 The QMS Representative shall prepare a meeting agenda and distribute the meeting agenda with the management review data.

3.3 The management review participants shall review all data presented, and where necessary, identify deficiencies. These may include deficiencies related to the:

- effectiveness of the QMS and related procedures
- ability of the Operating Authority to implement the QMS
- provision of adequate human and financial resources
- the level of consumer satisfaction.

3.4 For all deficiencies identified, the management review participants shall identify action items, personnel responsible for implementing action items, and timelines for action items.

3.5 Records of management reviews, recommendations, decisions, action items, personnel responsibilities, and timelines shall be forwarded to the Council Administrator upon completion.

Records shall be maintained by the QMS Representative. The records shall reflect all new action items and any decisions made by the review team, deficiencies, personnel responsible for action items, and timelines.

Figure 20.1 Example of a management review procedure.

20.10 Operational Plan: Management Review

Make sure that your operational plan is updated to include the management review procedure. Insert your management review procedure in the documentation, or if you would rather not insert documents into the operational plan binder, then just write down where those documents can be found.

Now that the information is prepared, it must be kept up-to-date. Identify the most effective method for making sure changes in the system are promptly updated in the QMS documentation. Give specific operating authority personnel responsibility for updating the information prepared under Element 20.

20.11 Training Personnel

The final step in this chapter is to ensure all relevant personnel in the operating authority are aware of the management review procedure requirements.

This can be done informally, simply by e-mailing, posting or discussing the information that you prepared in this chapter with all personnel.

Or, this can be performed later in the implementation during the QMS awareness sessions. In Chapter 21 – Completing the QMS Cycle, the task of training personnel in QMS concepts, including management reviews, will be discussed.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
Management reviewers have been designated and a methodology developed	
Items a) to p) in the PLAN component of DWQMS Element 20 have been considered	
Documentation and approval of the management review procedure	

21. Completing the QMS Cycle

21.1 Key Points in Chapter 21

- Once you have written your operational plan, your work is not done, the QMS cycle is continual.
- You must ensure personnel are aware of and use the information in the operational plan and supporting documents.
- The operational plan, the heart of your QMS, must be completed and endorsed by top management.

21.2 The QMS Cycle

A cycle is a full rotation through planning, doing, checking and improving your QMS, returning you back to planning activities. So far, by following this guidance document, you have completed the PLAN and DO parts of your QMS cycle. In order to be ready for a full audit, you must have completed at least one full cycle, which means you still must complete the CHECK and IMPROVE parts. Remaining in your CHECK and IMPROVE tasks are the requirements laid out in Chapters 22 through 24. However, before you are ready for those chapters, you must have implemented all of the requirements of the DWQMS covered in this guidance document to this point, including implementation of all of the steps that have been described.

You must start doing what you say you are doing in the operational plan for a short while, in order to generate some records, give personnel experience with their QMS requirements and responsibilities, and test the effectiveness of the methods that you have implemented.

A good method of ensuring that you have completed the PLAN and DO parts successfully is to ensure that all of the Chapter Checklists have been successfully completed.

This Chapter describes what is involved in completing your QMS cycle.

21.3 Operational Plan

By following each chapter in this guidance document, you have made decisions on how to implement each element of the DWQMS, and completed the implementation. Ensure that the operational plan:

- Includes or refers to all the required documentation for each element of the standard
- Accurately reflects the processes that you have actually implemented. Significant changes and adjustments typically occur in your first QMS cycle, so those changes must be updated accordingly in the operational plan.

21.4 QMS Awareness Training

Many of the steps that have been described in this guidance document require the final task to ensure personnel are aware of the QMS requirements that are being put into place, especially those related to their specific roles. Depending on their roles, personnel may need to be introduced to or reminded of

various QMS procedures and processes. It may be most effective to arrange for training staff grouped by roles, so that the trainer can focus on role-specific QMS responsibilities.

The table in Figure 21.1 lists some of the key topics that you may want to cover in QMS awareness training, grouped into trainee roles.

Role	QMS Topic
Top Management	• QMS policy • Operational Plan and endorsement • Responsibilities of top management • Top management commitment • Management review • What to expect from internal and third-party auditing • Review and provision of infrastructure and resources • Risk assessment and risk assessment outcomes
All Operating Authority staff	• What is a QMS? • QMS policy and operational plan • Organizational structure, roles, responsibilities and authorities • Competencies and personnel coverage • QMS communication • Essential supplies and services • Responsibilities of all staff • What to expect from internal and third-party auditing • Document and record control • Emergency procedures • The accreditation process • Who should be the QMS Representative?
Operators	• Competencies – awareness of the relevance of their duties and how they affect safe drinking water • Operators' responsibilities • Risk assessment and risk assessment outcomes • Essential supplies and services – Operator-specific responsibilities • Measurement and recording equipment calibration and maintenance – Operator-specific responsibilities • Sampling and recording – Operator-specific responsibilities • Emergency management - Operator-specific responsibilities
Maintenance	• Risk assessment and risk assessment outcomes • Infrastructure rehabilitation and renewal – maintenance-specific responsibilities • Measurement and recording equipment calibration and maintenance – maintenance-specific responsibilities • Sampling and recording – maintenance-specific responsibilities • Emergency management - maintenance-specific responsibilities
Administration/ Purchasing	• Essential supplies and services – specific responsibilities • Document and records control – administration-specific responsibilities
Emergency Response Teams	• Emergency management – response team responsibilities
Internal Auditors	Internal auditing - auditor responsibilities

Figure 21.1 QMS topics that may be covered in role-specific QMS awareness training.

Section 14.5 in Chapter 14 – Communications, describes various methods for training personnel. Decide which method of training may be most effective for your drinking-water system.

Remember some helpful goals when planning any training session:

- keep the training material interesting – if the trainer is not interested, the trainees won't be interested
- use examples to help people understand
- be brief, but don't skim through important information
- organize the trainees by similar roles, so that everyone can relate to specific examples
- use various media – don't just talk
- make it interactive – if trainees perform group activities or practise using forms right away, they are more likely to retain the information.

Ensure that you record who has received this information, to serve as a training record. If familiarity with this information is a competence requirement for people to perform their roles, add this requirement to your Competencies Requirements Table (described in Chapter 13 – Competencies and Personnel Coverage).

Before you will be ready for your internal audit, you must ensure that personnel are aware of their new roles and responsibilities, especially related to the topics listed above.

21.5 Updates to the QMS

As you continue to use the new information in your QMS, ensure that updates are made as required. Updates may be prompted by feedback from personnel, personal observation or top management as a result of observing an error, omission, inefficiency, or potential improvement.

Updates to the QMS may also come about as a result of changes in your operations, infrastructure, or personnel. Updates may result from reviewing the response during an emergency.

You will also likely update the QMS following an internal audit and management review, which are described in the next few chapters.

21.6 Completing and Endorsing the Operational Plan

It is now time to complete any missing or unfinished information in your operational plan. You created the required information for your operational plan in Chapters 9 through 20. Ensure that this information is complete.

When your operational plan has been completed, ensure that your document control requirements are applied, including a date of revision.

The Plan must be submitted to top management for endorsement, and to the owner.

21.7 Document and Record Requirements

At this stage in your implementation, you should check that all your required documents and records are in place. Check that the following documents are in place:

- Your operational plan.
- All of the reference documents that are cited in the operational plan.
- Training records.
- Other records.
- Reports and documents required by legislation.

Following the requirements under Chapter 9 – Document and Records Control, this information should be easy to locate, and retrieve.

Ready for the **Audit**

What do auditors like to see?

In completing this chapter and your first QMS cycle, auditors are looking for:

- Operating authority awareness of the QMS, at all levels (usually by interviewing and asking general questions, they can assess how well the QMS has been communicated).
- Records to show your QMS procedures are being followed.
- Documented, approved and implemented QMS policy, operational plan, and procedures.
- Updates and edits being made to procedures, forms or other documents, to show that the QMS is improving and changing. It is good to change documents to that the QMS is active.
- An endorsed operational plan with which operating authority personnel are aware.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
Personnel are aware of the QMS requirements that are applicable to their roles and responsibilities	
Personnel are using the information in the operational plan and the QMS procedures	
Records have been generated to show that procedures are being followed	
The operational plan is complete	
The operational plan has been endorsed by top management and by the owner	
DWQMS required documentation is in place	
The Ready for the Audit margin tips for this chapter have been completed	

22. Performing an Internal Audit

22.1 Key Points in Chapter 22

- An internal audit must be fully complete before you are eligible for an accreditation audit.
- Non-conformances identified in an internal audit are not a reflection of poor performance.
- You cannot learn how to conduct internal audits by reading this guidance document alone - auditing requires auditing skills, knowledge of the DWQMS, and experience.
- Internal audits require time to prepare and time to conduct.

22.2 Translating the DWQMS

Now that you have completed the first cycle of your QMS, you are ready to arrange for an internal audit. At least one full internal audit must be performed before you are eligible for an accreditation audit.

The audit schedule that was described in Chapter 19 – Plan for Internal Audit should reflect that an internal audit is now due.

22.3 Audit Preparation

Internal auditors should prepare for the audit by following the preparation information in your Internal Audit Procedure. Preparation activities should include the selection of audit team members, review of relevant process and QMS documentation, and development of audit checklists.

In the future, when an internal audit has already been completed, part of your audit preparations should be a review of previous audit results. Also, any corrective actions requested or taken for the processes to be audited should also be reviewed. It is very important to ensure that all corrective action requests are addressed in a timely manner.

22.4 Conducting the Audit

This phase of the audit consists of having conversations (some may refer to this as conducting interviews) with process owners and reviewing process results (records) to confirm the status of the requirements. As the audit is conducted, if items are found to be missing, incomplete, or ineffective, they will be identified as non-conformances.

Internal auditors should conduct the audit by following the Internal Audit Procedure. When this phase of the audit is complete, the auditors should have completed checklists, and identified non-conformances.

Initiating conversations or conducting interviews within the context of an internal audit can be a very difficult thing for many people to do. Even with a checklist in hand and knowledge of the process and related documentation a new auditor may experience a great deal of difficulty getting started and then staying on track. Whether you are the auditor, the operating authority being audited, or management – be patient.

Ready for the
Audit

What do auditors like to see?

Auditors will expect to see your internal audit results, such as completed checklists or a report, and the non-conformances identified.

Auditors will be checking that the internal auditors reviewed the conformance of your QMS to the DWQMS requirements, and also checked that the QMS has been implemented and maintained.

Auditors may interview the internal auditors to discuss their audit findings. Auditors may also interview personnel to whom the audit results were reported, and discuss actions taken.

Auditors may also review your corrective actions taken as a result of the non-conformances, how they were documented, and how they were checked to ensure they were effective corrections.

As the auditor you set the pace of the audit. Take the time you need to make notes. Take the time to review as many records or other documents as necessary to confirm that the process you are auditing has been effectively implemented.

22.5 Reporting and Follow-Up

Internal auditors must communicate their findings to the operating authority by following Internal Audit Procedure. Ensure a documented audit report is filed, as this is your proof that the internal audit was performed.

Internal auditors must follow up on the internal audit at a later date by reviewing the status of the non-conformances identified. Again, the follow-up instructions in the Internal Audit procedure should be followed.

22.6 Correcting Non-conformances

Addressing non-conformances is one of the most important parts of your internal audit, and your QMS. This is a crucial step in improving your QMS, and completing the QMS cycle.

Non-conformances identified in the Internal Audit must be addressed through corrective actions. **You should not initiate your accreditation audit until you are certain that you have addressed all non-conformances from your internal audit.**

Make sure to document the results of your follow-up activities and report the results to management. If you have rejected the corrective action proposed or taken, then the audit file remains open until acceptable corrective action has been completed.

The effectiveness of the corrective actions should also be checked and documented.

Chapter 24 – Maintenance and Continual Improvement of the QMS discusses continuous improvement and corrective actions in more detail.

22.7 Audit Schedule

Ensure the audit schedule has been updated, to reflect the next scheduled audit dates.

Non-conformances identified at this internal audit may influence the audit schedule, as described in Chapter 19 – Plan for Internal Audit.

22.8 Dilemma: Auditing Management Review

In the first cycle of any quality management system, a challenge always arises with completion of the internal audit and management review. You have not yet completed the management review; it is

covered in the next chapter. Management review is usually performed after the internal audit, because management review requires the results of the internal audit to be considered.

A Catch 22 situation arises due to this - the internal audit requires an audit of the management review portion of the QMS. Since management review is not yet complete, you will only be able to audit the planned review information, and the description of management review in the operational plan, but not any actual management review records. Thus the internal audit is incomplete, until management review records can be audited.

To overcome this, it is recommended that after the management review is completed, internal auditors review the management records to complete the internal audit. Results of the final review can then be added to the audit report, or issued as a small separate report.

This could be done in reverse, but scheduling management to re-convene a second time in order to re-review the results of the internal audit, is more challenging.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
Was an internal audit completed to evaluate conformity of the QMS with the requirements of the DWQMS?	
Was the internal audit procedure followed, including resources, audit preparation, conducting the audit, reporting, and follow-up?	
Was an audit report prepared?	
Were results of the internal audit communicated to key personnel?	
Are management review records scheduled to be reviewed after the management review is complete?	
Has the audit schedule been updated?	
Were corrective actions taken to fix the non-conformances?	
Were corrective actions checked for effectiveness?	
Were corrective actions documented?	

23. Performing a Management Review

23.1 Key Points in Chapter 23

- A completed management review of the entire QMS is a requirement for accreditation.
- Management review is the best method to keep the QMS and top management connected.
- The results of management review can summarize the condition of your QMS.

23.2 Utilizing the DWQMS

Now that you have completed the first cycle of your QMS, and your first internal audit, you are ready to arrange for a management review of the QMS. At least one management review must be performed before you are eligible for an accreditation audit. Use this information to meet the communication requirements between the operating authority and the owner (See Chapter 14 - Communications).

Ready for the
Audit

What do auditors like to see?

Auditors will expect to see your management review records, such as minutes, to review what was discussed, who attended, what material was provided to reviewers, decisions made, action items, and assignment of personnel plus timelines for deficiencies.

Auditors will review a sample of the decisions and action items, to investigate if an action has actually occurred.

Auditors may also interview managers who attended, to discuss the review process and decisions.

The overall intent of the auditor is to verify that improvement is actually taking place as a result of the management review.

23.3 Preparing for the Review

Staff with assigned responsibilities should prepare for the management review by following the information in your management review procedure, described in Chapter 20 – Plan for Management Review. Based on the requirements in your management review procedure, preparation activities should include:

- Scheduling of the meeting.
- Invitations to the reviewers.
- Collecting and summarizing the required material for review.
- Distributing the material to reviewers.
- Creating the meeting agenda.

23.4 Performing the Review

Following the agenda and the management review procedure, a management review should be performed. Management reviewers should discuss and consider all the items in the PLAN component of Element 20. Concerns that are identified should be communicated to top management, if top management is not directly involved in the management review.

Top management is responsible for considering these results, and identifying any deficiencies in the QMS. Top management must also identify action items to address these deficiencies. This can be done at the same management review meeting, if top management is part of the management review, or at an alternate meeting, or through e-mail or phone calls. The deficiencies and action items must be documented. Personnel responsible and timelines for

delivering action items must also be identified by top management, and recorded.

All of this information must then be communicated to the owner. Ensure that the owner receives the results of the management review, and the decisions, action items, personnel responsible and timelines, identified by top management. Figure 23.1 shows the result of a management review including top management decisions and action items.

Remember, the overall intent of management review is to complete the QMS cycle, ensuring top management sees how the QMS has performed, and initiates improvements. Continual improvement is also discussed in more detail in Chapter 24 – Maintenance and Continual Improvement of the QMS.

Decision or Deficiency	Action Item	Personnel Responsible	Timeline
Internal auditors do not have sufficient available time to perform a complete audit in one year, and need to perform audits more frequently than once per year to use their new audit skills	▪ Edit job descriptions for internal auditors to include auditor responsibilities. ▪ Supervisor, not auditor, must book calendar days for auditing, to block time, one month in advance of scheduled audit ▪ Audits in 2006 and 2007 to be quarterly, covering all elements in one year ▪ Auditors should allowed four hours of prep time before each audit ▪ Administrator to update QMS documents to reflect these changes	▪ Supervisor ▪ Admin (documents only)	▪ QMS documents due Nov 2006 ▪ Audits booked for year by Nov 2006
2008 expansion will mean new hires and updates to documents to reflect new equipment	▪ Ensure QMS training for new hires is integrated into the timeline and project task list for the expansion ▪ Ensure Supervisor is aware that QMS Rep will require extra time to review and update documents in 2007 and 2008	▪ Supervisor	▪ Due by Jan 2007

Note: *The above table has been developed to describe concepts and* ***should not*** *be interpreted as being necessarily suggested or required by the Ministry.*

Figure 23.1 Sample table of management review results, decisions, action items, personnel responsible and timelines.

Complete the Chapter Checklist below by checking off the items that have been completed. By completing all the items, you will be ready to move on to the next chapter.

CHAPTER CHECKLIST	*Check When Complete*
Completion of management review using the Management Review procedure	
Input to the management review included all of the items listed in the PLAN requirement of DWQMS Element 20	
The review outcome was documented, including action items and decisions	
Action items and decisions include assignment of personnel and timeframes for completion of tasks	
Action items are being carried out	

24. Maintenance and Continual Improvement of the QMS

24.1 Key Points in Chapter 24

- The journey is not over once you are accredited. It is just beginning.

- Plan for resources to remain available for the QMS every year.

24.2 Maintenance and Improvement Overview

You might have already heard someone say: "Anybody can be that good on that day, for that auditor. The real proof that you have a robust QMS is that it delivers positive results year-in-and-year-out." Developing and implementing a QMS means that a commitment is also required to maintain and improve it.

Day One for your QMS is the day **after** being recommended for accreditation. While the work associated with the development and implementation of your QMS has now been successfully completed, the use of your QMS, day-in and day-out, to manage the activities that provide safe drinking water begins.

To ensure that the QMS delivers positive results year-in and year-out, the operating authority must commit to:

- Keeping QMS documentation current.
- Reviewing any changes in employee turnover, sources of purchased supplies and services, and changes/upgrades in equipment and technology that may affect the QMS.
- Ensuring that new employees and new suppliers are advised of their responsibilities under the QMS.
- Maintaining the internal audit program and responding in a timely manner to all findings.
- Continuing to conduct meaningful management reviews.
- Closing the loop on all corrective actions.
- Initiating continual improvement projects.

Time and money will also be required for the third-party surveillance audits, as well as the re-accreditation of your full QMS.

Water treatment and distribution equipment is maintained in order to prolong its service. If you do not effectively maintain it, you will see decreased performance followed by the eventuality of a catastrophic failure. From time to time, you might also rebuild a piece of equipment to ensure that it meets ongoing performance requirements. But rarely, if ever, does maintaining a piece of equipment mean doing things to continually improve its ability to exceed the specifications it was originally designed to meet.

Maintenance of a QMS is different. The QMS must be flexible enough to meet the needs of a changing organization, the requirements of a changing infrastructure and even to keep pace with changing technologies. Your QMS is only limited by those who use it. So, if you are effectively maintaining and continually improving your QMS (to reflect changes in infrastructure or improvements in technologies),

you are also supporting the processes that give the owner and consumer confidence that they are drinking safe water.

24.3 Translating the DWQMS

What the Standard says…

21. Continual Improvement

DO - The Operating Authority shall strive to continually improve the effectiveness of its Quality Management System through the use of corrective actions.

What does it mean?

Element 21, the final element of the DWQMS, requires that you follow the QMS cycle – striving to make improvements to your QMS. Specifically, the DWQMS requires that you use corrective actions. A corrective action process helps to identify, document and make these improvements.

Continual Improvement is understanding what you already do well, then finding ways to do it better. Corrective Action is a method of improvement, and the solutions that are generated by those actions are also input to Continual Improvement.

Statistically speaking Continual Improvement addresses common causes, while Corrective Action addresses special causes.

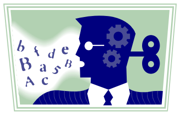
The purpose of your QMS is to reduce and ultimately eliminate the variation in your processes that may lead to non-conformances. During the development and implementation phase you are engaged primarily in corrective action – eliminating the causes or causes of non-conformances in your QMS.

Over time, as those non-conformances decrease, your efforts will shift to Preventative Action – finding ways to eliminate the potential for non-conformances in your QMS, not unlike what you may have done to meet the risk assessment requirements of Elements 7 and 8 of the DWQMS. Ultimately, the goal is to learn and apply continual improvement tools and methodologies to your QMS.

It is recommended that you take a broader approach to continual improvement. There are a lot of data generated by water treatment and distribution processes – especially the sampling and monitoring that occurs within those processes. The analysis of the data for trends, and opportunities for improvement should be considered as an integral part of your continual improvement efforts.

Commentary from all stakeholders generated by the publication of the QMS policy also serves as input – particularly those comments that directly relate to improving consumer satisfaction. Remember though, having a process for handling consumer complaints is part of your corrective-action process.

As your QMS stabilizes, the data providing information related to customer satisfaction, trends of the processes related to the production and distribution of safe drinking water and of supplier performance can be used to identify potential continuous improvement opportunities.



Technical **Terms**

Corrective Action is what we do to fix something that is broken – or, in QMS terms – an action to eliminate the cause of a detected non-conformity of the QMS with the requirements of the DWQMS or other undesirable situation.

24.4 Corrective Actions

The most efficient way to improve the effectiveness of the QMS, and to demonstrate that improvements have been made, is to record corrective actions. At a minimum, your process of recording QMS corrective actions should ensure the following information is recorded:

- The date that a quality-related problem, deviation, or non-conformance occurred, or was identified.
- A description of the non-conformance.
- A description of the corrective actions being taken.
- Responsibilities and timelines for corrective actions.
- A signoff by the responsible employee once the corrective actions are complete.

Corrective action should also prompt the operating authority to investigate, correct and record the root cause of the non-conformance, so that the problem does not recur.

Create a form to record corrective actions, or use an existing process for documenting corrective actions to include QMS corrective actions. Ensure that the information is recorded for each corrective action. The corrective action form is often used as a request form, so that correction is prompted by the initiation of the form. This makes the process of documenting corrective actions better planned.

A sample form is shown in Figure 24.1, and also provided in Appendix O.

Incorporate your form into your operational plan, and describe your general corrective action process.

QMS Corrective Action Form

Date:
July 5, 2006

Description:
Taste complaint not followed up properly, as required in Taste Complaint Procedure P101
On July 1, 2006, a taste complaint was called in to the main switchboard at 6:55 pm. The dayshift Operator (Joan) wrote down details of the complaint into the Operator's Log Book. Since the shift ended at 7 p.m., the Operator left instructions for the nightshift Operator (Tom) to continue the paperwork and follow up. The nightshift Operator read the Operator's Log Book, but did not see the instructions. The complaint was not documented or followed up properly. When the dayshift Operator returned for her next shift on July 5, 2006, she noticed that the complaint hadn't been handled and notified the QMS Representative.

Root Cause:
Personnel error – inattention to detail: When beginning the shift, the Operator did not perform a thorough review of all items listed in the Operator Log Book.
Verbal communication problem: Although written in the Log Book, the Operator did not also verbally discuss issues of significant importance with the next shift Operator, to ensure they were understood and acknowledged.

Corrective Action Taken:
All operators briefed in person by QMS Rep about:
- receiving and handling taste and odour complaints
- the importance of Log Book review, and
- the importance of verbal communication between shifts.

Communication Procedure P102 – modified to include specific instructions about shift change communication.
Also training Records were modified to reflect updated training in Taste and Odour complaints

Corrective Action Complete (signature and title):
Joan - Operator

Date Corrective Action Complete:
August 1, 2006

Corrective Action Effective after 90 days:
  - Yes
  - No communication issues between Operators
- Taste complaint August 5, 2006 handled correctly

Form last revised: November 1, 2005

Figure 24.1 Sample corrective action form.

PART II of III

Appendices – Templates and Examples

Note: The templates and sample entries provided in these Appendices have been provided to explain concepts and **should not** be interpreted as necessarily required or suggested by the Ministry of the Environment.

APPENDIX A: DWQMS GAP ANALYSIS CHECKLIST

DATE OF GAP ANALYSIS:

REVIEWER NAMES:

AREAS VISITED:

PEOPLE INTERVIEWED:

GAP ANALYSIS CHECKLIST

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
1. Quality Management System PLAN – The Operational Plan shall document a Quality Management System that meets the requirements of this Standard.		PL		
DO – The Operating Authority shall establish and maintain the Quality Management System in accordance with the requirements of this Standard and the policies and procedures documented in the Operational Plan.		DO		
2. Quality Management System Policy PLAN – The Operational Plan shall document a Quality Management System Policy that provides the foundation for the Quality Management System, and:		PL		
a) is appropriate for the size and type of the subject system,		a)		
b) includes a commitment to the maintenance and continual improvement of the Quality Management System,		b)		
c) includes a commitment to the consumer to provide safe drinking water,		c)		
d) includes a commitment to comply with applicable legislation and regulations, and		d)		
e) is in a form that provides for ready communication to all Operating Authority personnel, the Owner and the public.		e)		
DO – The Operating Authority shall establish and maintain a Quality Management System that is consistent with the Policy.		DO		
3. Commitment and Endorsement PLAN – The Operational Plan shall contain a written endorsement of its contents by Top Management and the Owner.		PL		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
DO – Top Management shall provide evidence of its commitment to an effective Quality Management System by:		DO		
a) ensuring that a Quality Management System is in place that meets the requirements of this Standard,		a)		
b) ensuring that the Operating Authority is aware of all applicable legislative and regulatory requirements,		b)		
c) communicating the Quality Management System according to the procedure for communications, and		c)		
d) determining, obtaining or providing the resources needed to maintain and continually improve the Quality Management System.		d)		
4. Quality Management System Representative PLAN – The Operational Plan shall identify a Quality Management System representative.		PL		
DO – Top Management shall appoint, and authorize a Quality Management System representative who, irrespective of other responsibilities, shall:		DO		
a) administer the Quality Management System by ensuring that processes and procedures needed for the Quality Management System are established and maintained,		a)		
b) report to Top Management on the performance of the Quality Management System and any need for improvement,		b)		
c) ensure that current versions of documents required by the Quality Management System are being used at all times,		c)		
d) ensure that personnel are aware of all applicable legislative and regulatory requirements that pertain to their duties for the operation of the subject system, and		d)		
e) promote awareness of the Quality Management System throughout the Operating Authority.		e)		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
5. Document and Records Control PLAN – The Operational Plan shall document a procedure for document and records control that describes how:		PL		
a) documents required by the Quality Management System are: i. kept current, legible and readily identifiable		a)i.		
ii. retrievable		a)ii.		
iii. stored, protected, retained and disposed of, and		a)iii.		
b) records required by the Quality Management System are: i. kept legible, and readily identifiable		b)i.		
ii. retrievable		b)ii.		
iii. stored, protected, retained and disposed of.		b)iii.		
DO – The Operating Authority shall implement and conform to the procedure for document and records control and shall ensure that the Quality Management System documentation for the subject system includes:		DO		
a) the Operational Plan and its associated policies and procedures,		a)		
b) documents and records determined by the Operating Authority as being needed to ensure the effective planning, operation and control of its operations, and		b)		
c) the results of internal and external audits and management reviews.		c)		
6. Drinking-Water System PLAN – The Operational Plan shall document, as applicable:		PL		
a) for the subject system: i. a description of the system including all treatment processes and distribution system components		i.		
ii. the name of the Owner and Operating Authority		ii.		
iii. a process flow chart		iii.		
iv. a description of the water source, including:		iv.		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
i. general characteristics of the raw water supply		i.		
ii. common event-driven fluctuations and		ii.		
iii. any resulting operational challenges and threats		iii.		
v. a description of any critical upstream or downstream processes relied upon to ensure the provision of safe drinking water.		v.		
b) if the subject system is an operational subsystem, a summary description of the municipal residential drinking-water system it is a part of.		b)		
c) if the subject system is connected to one or more other drinking-water systems owned by different owners, a summary description of those systems which:		c)		
i. indicates whether the subject system obtains water from or supplies water to those systems, and		i.		
ii. names the Owner and Operating Authority of those systems.		ii.		
DO – The Operating Authority shall ensure that the description of the drinking-water system is kept current.		DO		
7. Risk Assessment PLAN – The Operational Plan shall document a risk assessment process that:		PL		
a) identifies potential hazardous events and associated hazards,		a)		
b) assesses the risks associated with the occurrence of hazardous events,		b)		
c) ranks the hazardous events according to the associated risk,		c)		
d) identifies control measures to address the potential hazards and hazardous events,		d)		
e) identifies critical control points,		e)		
f) identifies a method to verify at least once a year, the currency of the information and the validity of the assumptions used in the risk assessment,		f)		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
g) ensures that a risk assessment is conducted at least once every thirty-six months, and h) considers the reliability and redundancy of equipment.		g) h)		
DO – The Operating Authority shall perform a risk assessment consistent with the documented process.		DO		
8. Risk Assessment Outcomes PLAN – The Operational Plan shall document: a) the identified potential hazardous events and associated hazards, b) the assessed risks associated with the occurrence of hazardous events, c) the ranked hazardous events, d) the identified control measures to address the potential hazards and hazardous events, e) the identified critical control points and their respective critical control limits, f) procedures and/or processes to monitor the critical control limits, g) procedures to respond to deviations from the critical control limits, and h) procedures for reporting and recording deviations from the critical control limits.		PL a) b) c) d) e) f) g) h)		
DO – The Operating Authority shall implement and conform to the procedures.		DO		
9. Organizational Structure, Roles, Responsibilities and Authorities PLAN – The Operational Plan shall: a) describe the organizational structure of the Operating Authority including respective roles, responsibilities and authorities, b) delineate corporate oversight roles, responsibilities and authorities in the case where the Operating Authority operates multiple subject systems,		PL a) b)		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
c) identify the person, persons or group of people within the management structure of the organization responsible for undertaking the Management Review,		c)		
d) identify the person, persons or group of people, having Top Management responsibilities required by this Standard, along with their responsibilities, and		d)		
e) identify the Owner of the subject system.		e)		
DO – The Operating Authority shall keep current the description of the organizational structure including respective roles, responsibilities and authorities, and shall communicate this information to Operating Authority personnel and the Owner.		DO		
10. Competencies PLAN – The Operational Plan shall document:		PL		
a) competencies required for personnel performing duties directly affecting drinking water quality,		a)		
b) activities to develop and maintain competencies for personnel performing duties directly affecting drinking water quality, and		b)		
c) activities to ensure that personnel are aware of the relevance of their duties and how they affect safe drinking water.		c)		
DO – The Operating Authority shall undertake activities to:		DO		
a) meet and maintain competencies for personnel directly affecting drinking water quality and shall maintain records of these activities, and		a)		
b) ensure that personnel are aware of the relevance of their duties and how they affect safe drinking water, and shall maintain records of these activities.		b)		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
11. Personnel Coverage PLAN – The Operational Plan shall document a procedure to ensure that sufficient personnel meeting identified competencies are available for duties that directly affect drinking water quality.		PL		
DO – The Operating Authority shall implement and conform to the procedure.		DO		
12. Communications PLAN – The Operational Plan shall document a procedure for communications that describes how the relevant aspects of the Quality Management System are communicated between Top Management and: a) the Owner, b) Operating Authority personnel, c) Suppliers, and d) the public.		PL		
		a)		
		b)		
		c)		
		d)		
DO – The Operating Authority shall implement and conform to the procedure.		DO		
13. Essential Supplies and Services PLAN – The Operational Plan shall: a) identify all supplies and services essential for the delivery of safe drinking water and shall state, for each supply or service, the means to ensure its procurement, and b) include a procedure by which the Operating Authority ensures the quality of essential supplies and services, in as much as they may affect drinking water quality.		PL		
		a)		
		b)		
DO – The Operating Authority shall implement the procedure.		DO		
14. Review and Provision of Infrastructure PLAN – The Operational Plan shall document a procedure for the annual review of the adequacy of the infrastructure necessary to operate and maintain the subject system.		PL		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
DO – The Operating Authority shall implement and conform to the procedure and communicate the findings of the review to the Owner.		DO		
15. Infrastructure Maintenance, Rehabilitation and Renewal PLAN – The Operational Plan shall document a summary of the Operating Authority's infrastructure maintenance, rehabilitation and renewal programs for the subject system.		PL		
DO – The Operating Authority shall: a) keep the summary current, b) communicate the programs to the Owner, and c) monitor the effectiveness of the maintenance program.		PL		
		a)		
		b)		
		c)		
16. Sampling, Testing and Monitoring PLAN – The Operational Plan shall document: a) a sampling, testing and monitoring procedure for process control and finished drinking water quality including requirements for sampling, testing and monitoring at the conditions most challenging to the subject system, b) a description of any relevant sampling, testing or monitoring activities that take place upstream of the subject system, and c) a procedure that describes how sampling, testing and monitoring results are recorded and shared between the Operating Authority and the Owner, where applicable.		PL		
		a)		
		b)		
		c)		
DO – The Operating Authority shall implement and conform to the procedures.		DO		
17. Measurement and Recording Equipment Calibration and Maintenance PLAN – The Operational Plan shall document a procedure for the calibration and maintenance of measurement and recording equipment.		PL		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
DO – The Operating Authority shall implement and conform to the procedure.		DO		
18. Emergency Management PLAN – The Operational Plan shall document a procedure to maintain a state of emergency preparedness that includes:		PL		
a) a list of potential emergency situations or service interruptions,		a)		
b) processes for emergency response and recovery,		b)		
c) emergency response training and testing requirements,		c)		
d) Owner and Operating Authority responsibilities during emergency situations,		d)		
e) references to municipal emergency planning measures as appropriate, and		e)		
f) an emergency communication protocol and an up-to-date list of emergency contacts.		f)		
DO – The Operating Authority shall implement and conform to the procedure.		DO		
19. Internal Audits PLAN – The Operational Plan shall document a procedure for internal audits that:		PL		
a) evaluates conformity of the QMS with the requirements of this Standard,		a)		
b) identifies internal audit criteria, frequency, scope, methodology and record-keeping requirements,		b)		
c) considers previous internal and external audit results, and		c)		
d) describes how Quality Management System corrective actions are identified and initiated.		d)		
DO – The Operating Authority shall implement and conform to the procedure and shall ensure that internal audits are conducted at least once every twelve months.		DO		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
20. Management Review PLAN - The Operational Plan shall document a procedure for management review that evaluates the continuing suitability, adequacy and effectiveness of the Quality Management System and that includes consideration of:		PL		
a) incidents of regulatory non-compliance,		a)		
b) incidents of adverse drinking-water tests,		b)		
c) deviations from critical control point limits and response actions,		c)		
d) the efficacy of the risk assessment process,		d)		
e) internal and third-party audit results,		e)		
f) results of emergency response testing,		f)		
g) operational performance,		g)		
h) raw water supply and drinking water quality trends,		h)		
i) follow-up on action items from previous management reviews,		i)		
j) the status of management action items identified between reviews,		j)		
k) changes that could affect the Quality Management System,		k)		
l) consumer feedback,		l)		
m) the resources needed to maintain the Quality Management System,		m)		
n) the results of the infrastructure review,		n)		
o) Operational Plan currency, content and updates, and		o)		
p) staff suggestions.		p)		
DO – Top Management shall implement and conform to the procedure and shall:		DO		
a) ensure that a management review is conducted at least once every twelve months,		a)		
b) consider the results of the management review and identify deficiencies and actions items to address the deficiencies,		b)		
c) provide a record of any decisions and action items related to the management review including the personnel responsible for delivering the action items and the proposed timelines for their implementation,		c)		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
d) report the results of the management review, the identified deficiencies, decisions and action items to the Owner.		d)		
21. Continual Improvement DO- The Operating Authority shall strive to continually improve the effectiveness of its Quality Management System through the use of corrective actions.		DO		

APPENDIX B: IMPLEMENTATION ACTION PLAN

Date of Implementation Action Plan:

Implementation Step	Tasks	When?	Who?
Setting Up the QMS Team **(Chapter 3)**	• Is a QMS Implementation Lead assigned? • Have QMS team members been set up if appropriate? • Have training needs been identified for the lead, team members, and management? • Has training been arranged for/provided? • Have the new roles of QMS lead and the QMS team, and their responsibilities, been communicated?		
Gap Analysis and Implementation Action Plan **(Chapter 4)**	• Have preparations for a gap analysis been completed? • Has a document review been performed? • Was a review of methods and procedures performed? • Was the gap analysis checklist completed? • What gaps were identified? • Were the gap analysis findings discussed with key personnel? • Was an implementation action plan created? • Does the implementation action plan include tasks and target dates, and were people assigned to complete the tasks? • Was the implementation action plan issued to key personnel? • Have key personnel been invited to the kick-off management meeting? • Has an agenda been prepared? • Was a kick-off management meeting held? • Were minutes of the meeting recorded? • Was the implementation action plan reviewed? • Was the timeline for implementation confirmed? • Will the implementation action plan be updated		

Implementation Step	Tasks	When?	Who?
	following changes or delays?		
The Quality Management System **(Chapter 5)**	• Has top management been identified?		
The Quality Management System Policy **(Chapter 6)**	• Has the QMS policy been created? • Have all of the checkpoints on the checklist for creating the QMS policy been completed? • Has the QMS policy been approved? • Does the operational plan include the QMS policy?		
Obtaining Commitment and Endorsement **(Chapter 7)**	• Has top management commitment been obtained?		
The QMS Representative **(Chapter 8)**	• Has a QMS Representative been appointed? • Does the QMS Representative have the authority to carry out the listed responsibilities? • Does the operational plan identify the QMS Representative?		
Document and Records Control **(Chapter 9)**	• Did you complete the quiz, to test your understanding of document and records control? • Are documents and records retrievable? • Can documents only be edited by authorized personnel? • Is a method in place to keep documents current? • Has a consistent format for documents and records been established? • Are all "Ready for the Audit" points in this chapter's margins in place? • Is a method in place for reviewing and approving documents? • Is a method in place for issuing updated documents, and removing obsolete ones? • Are documents and records protected? • Have retention times for records been determined?		

Implementation Step	Tasks	When?	Who?
	• Have disposal methods for records been determined? • Is the document and record control table complete? • Is the document and record control procedure written and approved? • Has the document and record control procedure been added to the operational plan?		
Drinking-Water System **(Chapter 10)**	• Has a description of the drinking-water system including all treatment processes and distribution system components, been prepared? • Were general characteristics of the raw water supply included in that description? • Were common event-driven fluctuations included in that description? • Were resulting operational challenges included in the description? • Is a process flow chart available? • Have critical upstream or downstream processes been described? • If the subject drinking-water system is part of a larger drinking-water system, has a summary description of the larger system been prepared? • If the subject drinking-water system is part of a larger drinking-water system, has the name of each owner and operating authority been included?		
Risk Assessment and Risk Assessment Outcomes **(Chapter 11)**	• Have you set up a team to perform the risk assessment? • Have you identified hazards and hazardous events? • Have you identified available monitoring control measures for each hazard? • Have you evaluated risks using a consistent method? • Have you ranked risks? • Have you identified your critical control points? • Have you included the minimum CCPs? • Have you established critical control limits for the		

Implementation Step	Tasks	When?	Who?
	CCPs? • Have you identified monitoring processes for CCPs? • Have you established response procedures for CCPs? • Have you completed the risk assessment table? • Have you created a procedure that describes how you performed this risk assessment? • Does the risk assessment procedure cover everything in element 7? • Is all of the documentation created in this chapter reviewed and approved? • Have the documentation gone to relevant personnel? • Does the operational plan have all of the required documents from elements 7 and 8?		
Organizational Structure, Roles, Responsibilities and Authorities **(Chapter 12)**	• Has a QMS Representative been identified? • Have you completed the responsibilities table, including roles, responsibilities and authorities for the operating authority? • Have you included roles, responsibilities and authorities for the operating authority when operating more than one drinking-water system? • Have you identified the owner of the drinking-water system? • Have you charted the organizational structure for the operating authority? • Have you arranged for top management to appoint a QMS Representative? • Have you ensured the QMS Representative was made aware of his or her responsibilities? • Is the QMS Representative included in the responsibilities table? • Is the QMS Representative included in the organizational chart? • Have you communicated the information in the responsibilities table and in the organizational chart throughout the operating authority?		
Competencies and	• Have required and desired competencies been		

Implementation Step	Tasks	When?	Who?
Personnel Coverage **(Chapter 13)**	identified? • Has a training matrix, or some means of describing how competencies are met been prepared? • Have training methods been described? • Have competency requirements that you have described been met? • Have personnel coverage procedures been prepared?		
Communications **(Chapter 14)**	• Has a communication procedure been documented? • Does the procedure includes a description of how the QMS is communicated to the owner? • Does the procedure includes a description of how the QMS is communicated to personnel? • Does the procedure includes a description of how the QMS is communicated to suppliers? • Does the procedure includes a description of how the QMS is communicated to the public?		
Essential Supplies and Services **(Chapter 15)**	• Have you created a list of essential supplies and services? • Have the means to ensure the procurement of the essential supplies and services been described? • Have you documented what quality requirements you have for all of the essential services and supplies? • Have you communicated these requirements to the purchasing department, to be used as selection criteria for new vendors? • Have you communicated these requirements to relevant staff? • Have you communicated these requirements to suppliers and service providers? • Do you have a process to monitor if supplies and services are meeting your requirements?		
Infrastructure **(Chapter 16)**	• Has a procedure for reviewing the adequacy of the infrastructure needed to operate and maintain the drinking-water system been created? • Has the adequacy of the infrastructure needed to operate the drinking-water system been		

Implementation Step	Tasks	When?	Who?
	reviewed? • Have the findings of the review been communicated to the owner? • Have summaries of the maintenance, rehabilitation and renewal programs for the infrastructure been created in the operational plan? • Have the programs been communicated to the owner? • Was this communication documented? • Is a process in place to keep these summaries current? • Is a process in place to monitor the effectiveness of the maintenance program? • Is the maintenance program being monitored for effectiveness? • Are documents being created to show this monitoring? • Are the results of this monitoring being communicated to the owner?		
Sampling and Monitoring **(Chapter 17)**	• Have you listed the sampling, testing and monitoring parameters for your drinking-water system? • Have you included targets, or acceptable ranges, for those parameters? • Have you included methods for responding when those targets or acceptable ranges are exceeded? • Have you included any upstream sampling and monitoring? • Have you described sampling, testing and monitoring under challenging conditions? • Have you described how sampling and monitoring results are recorded? • Have you listed the measurement and recording equipment? • Have you described the calibration of this equipment, including method, frequency, planning and results? • Have you described how the results are shared		

Implementation Step	Tasks	When?	Who?
	between owners and operating authorities? • Is your calibration of sampling and monitoring equipment up-to-date?		
Emergency Preparedness and Response **(Chapter 18)**	• Have all potential emergencies been identified? • Have emergency procedures been documented? • Do the procedures describe responsibilities? • Do the procedures describe communication during an emergency? • Do the procedures describe what sampling is required for response and recovery? • Do the procedures describe response teams you will utilize? • Do the procedures refer to municipal planning measures? • Do the procedures include specific response actions that must be taken? • Do the procedures include recovery instructions? • Do the procedures include your requirements for documenting the emergency, and any follow-up reporting required? • Are contact lists included in the procedures? • Is a communication protocol included? • Are training requirements for emergency procedures documented? • Has required training in emergency procedures been completed? • Has testing of emergency plans been planned and documented? • Have emergency procedures been reviewed, approved and distributed?		
Plan for Internal Audit **(Chapter 19)**	• Has an internal audit procedure been documented and approved? • Does the procedure include a description of who will perform internal audits, including the person's training and experience requirements? • Does the procedure include a description of audit frequency and scope and how it is planned? • Has an audit schedule been created?		

Implementation Step	Tasks	When?	Who?
	• Does the procedure include a description of audit team member selection in preparation for an audit? • Does the procedure include a description of how audit team members review information in preparation for an audit? • Does the procedure include a description of how audit checklists are prepared? • Does the procedure include a description of how the audit is conducted? • Does the procedure include a description of how the audit is reported? • Does the procedure include a description of how the audit is followed up?		
Plan for Management Review **(Chapter 20)**	• Have you designated who will perform the management review, and how? • Does the management review procedure require items a) to p) in the plan component of Element 20 to be considered? • Has the management review procedure been documented and approved?		
Completing the QMS Cycle **(Chapter 21)**	• Are personnel aware of the QMS requirements that are applicable to their roles and responsibilities? • Are personnel using the information in the operational plan and the QMS procedures? • Have records been generated to show that procedures are being followed? • Is the operational plan complete? • Has the operational plan been endorsed by top management and by the owner? • Is DWQMS required documentation in place? • Are the "Ready for the Audit" margin points for this chapter in place?		
Performing and Internal Audit **(Chapter 22)**	• Was an internal audit completed? • Was the internal audit procedure followed, including resources, audit preparation, conducting the audit, reporting, and follow-up? • Was an audit report prepared?		

Implementation Step	Tasks	When?	Who?
	• Were results of the internal audit communicated to key personnel? • Are management review records scheduled to be reviewed after the management review is complete? • Has the audit schedule been updated? • Were corrective actions made to fix non-conformances? • Were corrective actions checked for effectiveness? • Were corrective actions documented?		
Performing a Management Review **(Chapter 23)**	• Was a management review completed? • Was the management review procedure followed? • Do inputs to the management review include all of those listed in Element 20 of the DWQMS? • Was the review, including action items and decisions, documented? • Did action items and decisions include assignment of personnel and timeframes for completion of those tasks? • Are action items being carried out?		

APPENDIX C: DOCUMENT AND RECORD CONTROL TABLE

Date of Revision:								**NR = not required**
		Document Requirements				**Record Requirements**		
Document or Record?	**Type of Document**	**File Location (of master)**	**Location of Printed Documents**	**Authorized Editor**	**Reviewers/ Approvers**	**File Location**	**Retention Time**	**Disposal Method**
D	Emergency Response Manual	O:/QMS/emerg	control room, QMS office, front lobby, loading dock	H&S Committee	Senior Managers	NR	NR	NR
R	External lab test results	NR	NR	NR	NR	control room	15 years	shred

APPENDIX D: RISK ASSESSMENT TABLE

Activity or Process Step	Description of Hazardous Event/ Hazard	Control Measures	Likelihood	Severity	Detectability	Total	CCP?	Critical Control Limits	Monitoring Procedures Processes	Response Procedures
Filters	Filter turbidity breakthrough Biological contamination due to ineffective chemically assisted filtration and pathogen removal	Automatic controls stop water production on high turbidity. Backwash initiated, followed by filter to waste cycle.	2	4	1	7	Yes	0.15 NTU – automatic filter backwash sequence initiated 0.20 NTU – alarm sent out and flow through filter is stopped 0.5 NTU 95 percent of the time – regulatory limit	Continuous on-line monitoring of filtered water turbidity with automatic controls. Alarm if limits exceeded.	Automatic controls stop water filtration on high filtered water turbidity. Operator investigates. Performance of other filters and the operation of the chemical feed systems are reviewed. Key raw water parameters and settled water turbidity is checked. If necessary jar tests are completed and the coagulant and polymer addition are adjusted to optimize performance.

APPENDIX E: RESPONSIBILITIES TABLE

Date of Revision:

Role	Responsibilities	Authorities
Operating Authority President	• Ensures operations are performed as per the Contract between the OA and the Owner • Obtains resources or infrastructure as necessary from the Owner • Provides resources or infrastructure as necessary • Ensures that the DWQMS is implemented and maintained, and that the operating authority is accredited	- To perform listed responsibilities - To recommend improvements or changes according to the Operating Contract - To implement improvements or changes according to the Operating Contract

APPENDIX F: COMPETENCIES TABLE

Competency Requirements Table		
Role	**Required Competencies**	**Desired Competencies**
WTP Foreman	• WTP Class III Certification • Distribution Class I Certification • Supervision Experience/Training • SCADA Training • WHMIS • Mechanical Aptitude • Internal Auditor Training • First Aid (Including CPR) • MS Word & Excel	• Leadership Training • Distribution Class III Certification

APPENDIX G: TRAINING MATRIX

(Operating Authority) Training Matrix: last updated 01/12/2006								
Jan 1 2006 to Dec 31 2008			**List training here (duration in hours)**	**List training here (duration in hours)**	**List training here (duration in hours)**	**List training here (duration in hours)**	**List training here (duration in hours)**	**Total Hours to Date**
Employee	**Role**	**Expiry (years)**	add expiry here	add expiry here	add expiry here	add expiry here	add expiry here	
employee name here	employee role here		add date of training here	add date of training here	add date of training here	add date of training here	add date of training here	sum hours of training here

APPENDIX H: SUPPLIES AND SERVICES TABLE

ESSENTIAL SUPPLY OR SERVICE	PROCUREMENT	QUALITY REQUIREMENTS
Chlorine gas supply	• Chlorine gas catalogue # XX111, delivered in tonners • 9 tonners in total at all times, 2 in use. When 2 on scales are emptied, 2 are ordered by Operator, and order is recorded in Op Log book • Chlorine Supply Inc. 1-800-555-6224 • Tonners available at Lake Ontario Municipality water plant if needed in emergency	• Employees receive regular TDG & WHMIS training • Drivers have clean driving records • Delivery vehicles equipped with the appropriate safety and environmental gear in the event of a spill • Sufficient warehouse stock • Documented verification of load contents provided with each shipment • Product is NSF approved • Certificate of Analysis provided with all shipments • Must sign in for entry, provide documentation before offloading, and offload under Operator's supervision only

APPENDIX I: SAMPLING AND MONITORING TABLE

Date of Revision:

NR = not required

PARAMETER						CALIBRATION				
Sampling or Monitoring Parameter	**Location**	**Quality Targets**	**Response**	**Challenging Conditions**	**Records**	**Devices**	**Method**	**Frequency**	**Schedule**	**Results**
Water depth – SCADA monitors and alarms	Intake Well	Depth greater than 4 meters	Investigate reason for low water levels	Intake blockage, frazil ice	Record in log book	Ultrasonics transducer	Instrument Tech uses ACME Ultrasonics equipment manual in control room	Quarterly	CMMS	CMMS, and hard copy in control room

APPENDIX J: EMERGENCY PROCEDURES

DRINKING WATER SYSTEM:

REVISION DATE:

REVIEWED BY:

APPROVED BY:

RELEASE COPIES TO:

APPENDIX J (CONT'D)…

POTENTIAL EMERGENCIES

POTENTIAL EMERGENCIES	
Description of Emergency	**Potential Outcome**
Chemical spill in wellhead capture zone	Health risk, contamination of source water, contamination of environment, service disruption

APPENDIX J (CONT'D)…

RESPONSIBILITIES (Chain of Command)

Name and Title	Responsibilities During Emergency
John Smith Water System Manager	Overall management and decision making for the water system, on behalf of the Owner and Operating Authority. The lead for managing the emergency, providing information to government agencies, the public and the news media. All external communication is approved by the Water System Manager.

APPENDIX J (CONT'D)…

RESPONSE AND RECOVERY ACTIONS – SPECIFIC EMERGENCIES

Emergency	Specific Response and Recovery Actions
Pipeline breakage	**Indicators:** • Distribution system reservoirs and pumping station pressures and levels are monitored continuously through the SCADA system. • A large breakage will be indicated by a sudden and possibly large *drop in normal pressure* that will not correspond to any pump shutdown. • Pipeline breaks will sometimes cause abnormally *high flow from discharge of pumps* causing *high amperage draw* by pump motor. • *Reservoir level* will also begin to drop. **Response:** 1. Operator shall shut down all pumps feeding the broken line immediately. 2. Operator shall close all remotely controlled pipeline isolation valves immediately. 3. Operator shall notify the Project Manager and the Operations Manager of the situation (see Contacts List). 4. Operator shall dispatch maintenance staff to the location 5. Maintenance staff shall assess the situation, for impacts, resources required for repair, and timing estimates 6. Maintenance staff shall report findings to Operator and Operations Manager 7. If the break is on the transmission main, staff shall follow Contingency Plan Procedure. 8. If the break is not on the transmission main, Maintenance shall remain until responders from Distribution System arrive, and proceed to Step 11 9. If the break is in on the transmission main, Maintenance shall initiate repair, and dispatch for subcontractor assistance as necessary 10. Operator shall dispatch additional maintenance staff to the location if the problem pertains to the transmission main System. 11. Operations Manager shall inform the Municipality (see Contacts List) in the affected area of the situation regardless of whose equipment is affected (pressure losses will generate consumer complaints). 12. Operator shall record the incident in the Operator's Log Book. **Recovery:** 1. 2.

APPENDIX J (CONT'D)…

EMERGENCY CONTACT INFORMATION

Contact Name	Number	Reason For Contacting	Who Contacts	Special Instructions
System Owner	(905) 555-4545	Any emergency event	Water System Manager or designate	Record call in Operator Log Book
Medical Officer of Health	(905) 555-5656	Emergency involving confirmed contamination of treated water	Water System Manager or designate	Record call in Operator Log Book

APPENDIX J (CONT'D)…

TRAINING REQUIREMENTS

Who	Emergency Topic	Purpose
Staff with response roles	Specific response instructions	Staff with specific detection, response, contact or recovery responsibilities should be trained in response and recovery procedures. Be sure to cover their specific responsibilities.

TESTING REQUIREMENTS

Emergency	Type of Test	Frequency	Instructions
Pipeline break	Drill	Every 3 years	All water system staff involved, notice provided, mock pipeline break, professional trainer to co-ordinate.

APPENDIX K: INTERNAL AUDIT SCHEDULE

Date of Revision: September 2006

Date	Process	DWQMS Element	Auditor(s)
October 2006	Treatment plant	All DWQMS elements	JM
November 2006	Distribution	All DWQMS elements	DF

APPENDIX L: INTERNAL AUDIT PROCEDURE

Internal audits of the QMS shall be conducted to confirm that the QMS meets or exceeds the requirements of the DWQMS Standard, and that it is effectively implemented and maintained.

Audit Schedule

Internal audits are scheduled throughout the year. The audits are scheduled by Element by month. The assigned auditor's name also appears on the schedule.

The audit schedule is developed and published at the end of February each year for the upcoming fiscal year by the Director of Operations. There are no audits scheduled for July, August or March.

Each element of the Standard is audited at least once during the fiscal year.

Audit Preparation

Conducting the Audit

Audit Report and Follow-Up

APPENDIX M: INTERNAL AUDIT CHECKLIST

DATE OF INTERNAL AUDIT:

AUDITOR NAMES:

AREAS VISITED:

PEOPLE INTERVIEWED:

DOCUMENTS VIEWED:

INTERNAL AUDIT CHECKLIST

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
1. Quality Management System PLAN – The Operational Plan shall document a Quality Management System that meets the requirements of this Standard.		PL		
DO – The Operating Authority shall establish and maintain the Quality Management System in accordance with the requirements of this Standard and the policies and procedures documented in the Operational Plan.		DO		
2. Quality Management System Policy PLAN – The Operational Plan shall document a Quality Management System Policy that provides the foundation for the Quality Management System, and:		PL		
a) is appropriate for the size and type of the subject system,		a)		
b) includes a commitment to the maintenance and continual improvement of the Quality Management System,		b)		
c) includes a commitment to the consumer to provide safe drinking water,		c)		
d) includes a commitment to comply with applicable legislation and regulations, and		d)		
e) is in a form that provides for ready communication to all Operating Authority personnel, the Owner and the public.		e)		
DO – The Operating Authority shall establish and maintain a Quality Management System that is consistent with the Policy.		DO		
3. Commitment and Endorsement PLAN – The Operational Plan shall contain a written endorsement of its contents by Top Management and the Owner.		PL		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
DO – Top Management shall provide evidence of its commitment to an effective Quality Management System by:		DO		
a) ensuring that a Quality Management System is in place that meets the requirements of this Standard,		a)		
b) ensuring that the Operating Authority is aware of all applicable legislative and regulatory requirements,		b)		
c) communicating the Quality Management System according to the procedure for communications, and		c)		
d) determining, obtaining or providing the resources needed to maintain and continually improve the Quality Management System.		d)		
4. Quality Management System Representative PLAN – The Operational Plan shall identify a Quality Management System representative.		PL		
DO – Top Management shall appoint, and authorize a Quality Management System representative who, irrespective of other responsibilities, shall:		DO		
a) administer the Quality Management System by ensuring that processes and procedures needed for the Quality Management System are established and maintained,		a)		
b) report to Top Management on the performance of the Quality Management System and any need for improvement,		b)		
c) ensure that current versions of documents required by the Quality Management System are being used at all times,		c)		
d) ensure that personnel are aware of all applicable legislative and regulatory requirements that pertain to their duties for the operation of the subject system, and		d)		
e) promote awareness of the Quality Management System throughout the Operating Authority.		e)		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
5. Document and Records Control PLAN – The Operational Plan shall document a procedure for document and records control that describes how: a) documents required by the Quality Management System are: i. kept current, legible and readily identifiable ii. retrievable iii. stored, protected, retained and disposed of, and b) records required by the Quality Management System are: i. kept legible, and readily identifiable ii. retrievable iii. stored, protected, retained and disposed of.		PL		
		a)i.		
		a)ii.		
		a)iii.		
		b)i.		
		b)ii.		
		b)iii.		
DO – The Operating Authority shall implement and conform to the procedure for document and records control and shall ensure that the Quality Management System documentation for the subject system includes: a) the Operational Plan and its associated policies and procedures, b) documents and records determined by the Operating Authority as being needed to ensure the effective planning, operation and control of its operations, and c) the results of internal and external audits and management reviews.		DO		
		a)		
		b)		
		c)		
6. Drinking-Water System PLAN – The Operational Plan shall document, as applicable: a) for the subject system: i. a description of the system including all treatment processes and distribution system components ii. the name of the Owner and Operating Authority iii. a process flow chart iv. a description of the water source, including:		PL		
		i.		
		ii.		
		iii.		
		iv.		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
i. general characteristics of the raw water supply ii. common event-driven fluctuations and iii. any resulting operational challenges and threats v. a description of any critical upstream or downstream processes relied upon to ensure the provision of safe drinking water. b) if the subject system is an operational subsystem, a summary description of the municipal residential drinking-water system it is a part of. c) if the subject system is connected to one or more other drinking-water systems owned by different owners, a summary description of those systems which: i. indicates whether the subject system obtains water from or supplies water to those systems, and ii. names the Owner and Operating Authority of those systems.		i. ii. iii. v. b) c) i. ii.		
DO – The Operating Authority shall ensure that the description of the drinking-water system is kept current.		DO		
7. Risk Assessment PLAN – The Operational Plan shall document a risk assessment process that: a) identifies potential hazardous events and associated hazards, b) assesses the risks associated with the occurrence of hazardous events, c) ranks the hazardous events according to the associated risk, d) identifies control measures to address the potential hazards and hazardous events, e) identifies critical control points, f) identifies a method to verify at least once a year, the currency of the information and the validity of the assumptions used in the risk assessment,		PL a) b) c) d) e) f)		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
g) ensures that a risk assessment is conducted at least once every thirty-six months, and		g)		
h) considers the reliability and redundancy of equipment.		h)		
DO – The Operating Authority shall perform a risk assessment consistent with the documented process.		DO		
8. Risk Assessment Outcomes		PL		
PLAN – The Operational Plan shall document: a) the identified potential hazardous events and associated hazards,		a)		
b) the assessed risks associated with the occurrence of hazardous events,		b)		
c) the ranked hazardous events,		c)		
d) the identified control measures to address the potential hazards and hazardous events,		d)		
e) the identified critical control points and their respective critical control limits,		e)		
f) procedures and/or processes to monitor the critical control limits,		f)		
g) procedures to respond to deviations from the critical control limits, and		g)		
h) procedures for reporting and recording deviations from the critical control limits.		h)		
DO – The Operating Authority shall implement and conform to the procedures.		DO		
9. Organizational Structure, Roles, Responsibilities and Authorities		PL		
PLAN – The Operational Plan shall: a) describe the organizational structure of the Operating Authority including respective roles, responsibilities and authorities,		a)		
b) delineate corporate oversight roles, responsibilities and authorities in the case where the Operating Authority operates multiple subject systems,		b)		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
c) identify the person, persons or group of people within the management structure of the organization responsible for undertaking the Management Review,		c)		
d) identify the person, persons or group of people, having Top Management responsibilities required by this Standard, along with their responsibilities, and		d)		
e) identify the Owner of the subject system.		e)		
DO – The Operating Authority shall keep current the description of the organizational structure including respective roles, responsibilities and authorities, and shall communicate this information to Operating Authority personnel and the Owner.		DO		
10. Competencies PLAN – The Operational Plan shall document:		PL		
a) competencies required for personnel performing duties directly affecting drinking water quality,		a)		
b) activities to develop and maintain competencies for personnel performing duties directly affecting drinking water quality, and		b)		
c) activities to ensure that personnel are aware of the relevance of their duties and how they affect safe drinking water.		c)		
DO – The Operating Authority shall undertake activities to:		DO		
a) meet and maintain competencies for personnel directly affecting drinking water quality and shall maintain records of these activities, and		a)		
b) ensure that personnel are aware of the relevance of their duties and how they affect safe drinking water, and shall maintain records of these activities.		b)		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
11. Personnel Coverage PLAN – The Operational Plan shall document a procedure to ensure that sufficient personnel meeting identified competencies are available for duties that directly affect drinking water quality.		PL		
DO – The Operating Authority shall implement and conform to the procedure.		DO		
12. Communications PLAN – The Operational Plan shall document a procedure for communications that describes how the relevant aspects of the Quality Management System are communicated between Top Management and: a) the Owner, b) Operating Authority personnel, c) Suppliers, and d) the public.		PL		
		a)		
		b)		
		c)		
		d)		
DO – The Operating Authority shall implement and conform to the procedure.		DO		
13. Essential Supplies and Services PLAN – The Operational Plan shall: a) identify all supplies and services essential for the delivery of safe drinking water and shall state, for each supply or service, the means to ensure its procurement, and b) include a procedure by which the Operating Authority ensures the quality of essential supplies and services, in as much as they may affect drinking water quality.		PL		
		a)		
		b)		
DO – The Operating Authority shall implement the procedure.		DO		
14. Review and Provision of Infrastructure PLAN – The Operational Plan shall document a procedure for the annual review of the adequacy of the infrastructure necessary to operate and maintain the subject system.		PL		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
DO – The Operating Authority shall implement and conform to the procedure and communicate the findings of the review to the Owner.		DO		
15. Infrastructure Maintenance, Rehabilitation and Renewal PLAN – The Operational Plan shall document a summary of the Operating Authority's infrastructure maintenance, rehabilitation and renewal programs for the subject system.		PL		
DO – The Operating Authority shall: a) keep the summary current, b) communicate the programs to the Owner, and c) monitor the effectiveness of the maintenance program.		PL		
		a)		
		b)		
		c)		
16. Sampling, Testing and Monitoring PLAN – The Operational Plan shall document: a) a sampling, testing and monitoring procedure for process control and finished drinking water quality including requirements for sampling, testing and monitoring at the conditions most challenging to the subject system, b) a description of any relevant sampling, testing or monitoring activities that take place upstream of the subject system, and c) a procedure that describes how sampling, testing and monitoring results are recorded and shared between the Operating Authority and the Owner, where applicable.		PL		
		a)		
		b)		
		c)		
DO – The Operating Authority shall implement and conform to the procedures.		DO		
17. Measurement and Recording Equipment Calibration and Maintenance PLAN – The Operational Plan shall document a procedure for the calibration and maintenance of measurement and recording equipment.		PL		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
DO – The Operating Authority shall implement and conform to the procedure.		DO		
18. Emergency Management PLAN – The Operational Plan shall document a procedure to maintain a state of emergency preparedness that includes:		PL		
a) a list of potential emergency situations or service interruptions,		a)		
b) processes for emergency response and recovery,		b)		
c) emergency response training and testing requirements,		c)		
d) Owner and Operating Authority responsibilities during emergency situations,		d)		
e) references to municipal emergency planning measures as appropriate, and		e)		
f) an emergency communication protocol and an up-to-date list of emergency contacts.		f)		
DO – The Operating Authority shall implement and conform to the procedure.		DO		
19. Internal Audits PLAN – The Operational Plan shall document a procedure for internal audits that:		PL		
a) evaluates conformity of the QMS with the requirements of this Standard,		a)		
b) identifies internal audit criteria, frequency, scope, methodology and record-keeping requirements,		b)		
c) considers previous internal and external audit results, and		c)		
d) describes how Quality Management System corrective actions are identified and initiated.		d)		
DO – The Operating Authority shall implement and conform to the procedure and shall ensure that internal audits are conducted at least once every twelve months.		DO		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
20. Management Review PLAN - The Operational Plan shall document a procedure for management review that evaluates the continuing suitability, adequacy and effectiveness of the Quality Management System and that includes consideration of: a) incidents of regulatory non-compliance, b) incidents of adverse drinking-water tests, c) deviations from critical control point limits and response actions, d) the efficacy of the risk assessment process, e) internal and third-party audit results, f) results of emergency response testing, g) operational performance, h) raw water supply and drinking water quality trends, i) follow-up on action items from previous management reviews, j) the status of management action items identified between reviews, k) changes that could affect the Quality Management System, l) consumer feedback, m) the resources needed to maintain the Quality Management System, n) the results of the infrastructure review, o) Operational Plan currency, content and updates, and p) staff suggestions.		PL a) b) c) d) e) f) g) h) i) j) k) l) m) n) o) p)		
DO – Top Management shall implement and conform to the procedure and shall: a) ensure that a management review is conducted at least once every twelve months, b) consider the results of the management review and identify deficiencies and actions items to address the deficiencies, c) provide a record of any decisions and action items related to the management review including the personnel responsible for delivering the action items and the proposed timelines for their implementation,		DO a) b) c)		

DWQMS Requirement	Notes	Method in Place?	Documented?	Gap?
d) report the results of the management review, the identified deficiencies, decisions and action items to the Owner.		d)		
21. Continual Improvement DO- The Operating Authority shall strive to continually improve the effectiveness of its Quality Management System through the use of corrective actions.		DO		

APPENDIX N: QMS SCHEDULE

QMS Activity	Frequency
Review all QMS documents (operational plan, QMS policy, all procedures, hazard analysis, PFDs, etc).	At least once a year.
Review emergency procedures and emergency contact lists.	At least once a year.
Perform internal audit.	At least once a year for all elements.
Perform management review.	At least once a year.
Test emergency procedures.	At least once a year.
Review competencies.	At least once a year.
Review and update training matrix and schedule.	Annually, prior to the management review.
Review and conduct hazard analysis.	Prior to a process or equipment change and after a significant change to the source water.
Review the status of corrective actions.	Quarterly.
Review status of continual improvement initiatives.	Per initiative/project schedule.
Perform QMS awareness training.	At least once a year or with new hires or temporary staff.

APPENDIX O: CORRECTIVE ACTION FORM

Date:

Description:

Taste complaint not followed up properly, as required in Taste Complaint Procedure P101.

On July 1/06, a taste complaint was called in to the main switchboard at 6:55pm. The dayshift Operator (Joan) wrote down details of the complaint into the Operator's Log Book. Since the shift ended at 7pm, the Operator left instructions for the nightshift Operator (Tom) to continue the paperwork and follow up. The nightshift Operator read the Operator's Log Book, but did not see the instructions. The complaint was not documented or followed up properly. When the dayshift Operator returned for her next shift on July 5, 2006, she noticed that the complaint hadn't been handled and notified the QMS Representative.

Root Cause:

Corrective Action Taken:

Corrective Action Complete (signature and title):

Date Corrective Action Complete:

Corrective Action Effective after 90 days:

Form last revised: November 1, 2005

APPENDIX P: DOCUMENT AND RECORD CONTROL PROCEDURE

This procedure defines the actions and responsibilities that ensure control of all documents affecting the Quality Management System (QMS). This procedure also defines the mechanism for maintaining records generated by ABC Water Company.

Reason For Procedure

Creating, revising, approving and releasing documents must be performed in a consistent manner, so that documents can be easily retrieved, stay current and accurate, and are available to the user. All obsolete documents must be promptly removed from use.

Records are the best way to demonstrate:

- Conformance to the Drinking Water Quality Management Standard
- Compliance to legal and other requirements, and
- Suitability, adequacy and effectiveness of the QMS.

Thus, maintaining proper records is critical, and must be performed consistently.

Background

The following QMS documents are controlled under this procedure:
Internal QMS documents:

- QMS manual
- QMS procedures, forms, checklists
- Hazard Analysis and Critical Control Points
- Other documents as identified by the Quality Coordinator

External QMS documents:

- Material Safety Data Sheets (MSDS)
- Permits, licenses, approvals or other legal documents filed at the ABC Water Company
- Relevant applicable legislation

A record is a 'snapshot' of the conditions of the ABC Water Company. QMS records include:

- Completed forms and checklists
- Process data spreadsheets
- Logbooks
- Records that track critical control points (analyzer data, calibration documents)
- Contractor and supplier information, lists of critical supplies and services, inventories of these
- Inspection and maintenance records, work orders
- Key outputs (flow data, chemical parameters)
- Monitoring and measurement data
- Audit results
- Communication records
- Minutes of meetings
- Training records and certificates
- Records of adverse drinking water occurrences and conditions
- Other records as identified by the Quality Coordinator

Responsibilities

- The Quality Coordinator (QC) creates, edits, releases QMS documents, and controls obsolete documents
- The District Director approves all newly created and edited QMS documents prior to their release.

- Operators complete and file records related to test results and inspections, and record unscheduled occurrences in the Operator Log Book
- The Maintenance Manager completes and files records related to preventive and unscheduled maintenance, through the Maintenance Management System
- The QC files QMS records

Reviewing/Approving Documents

- At least once per year, or as noted on the document header, the QC reviews QMS documents for any required updates or modifications
- The QC may delegate document modifications to the Administrative Assistant
- The QC forwards edited or newly created documents electronically to the District Director, for review and approval
- The District Director reviews the content, format, and intent of the document, and approves if satisfactory
- If approved, the District Director returns the document electronically to the QC, with comments if required
- If not approved, the District Director notes concerns and clearly notifies QC in the email that document is not approved
- Edits to the document are summarized on the revision block located within the body of the document

Format of Documents

The QC creates internal QMS documents, or makes appropriate edits
The format of the procedures shall cover the following:

- the 'who', 'what', and 'how'
- related documentation
- how documents are filed
- purpose and reason
- a QMS header, including document name, revision date, and number
- page number and total pages
- Three digit document numbers are allocated by the Administrative Assistant

Format of forms shall include the document name, form number and revision date

Releasing of Documents

- All internal QMS documents are electronically controlled, with only the District Director, QC or Administrative Assistant having electronic access to modify them
- All printed versions of QMS documents are marked 'uncontrolled'
- Printed versions of QMS procedures and forms are available in the QC office or in the Control Room
- All external QMS documents are filed in the QC office or in the Control Room
- External documents of a legal nature, including C of A's and other permits, are controlled by the Owner, and copied to the QC
- Printed legislation is uncontrolled. When referring to legislation, the QC refers to the online legislation

Obsolete Documents

- Obsolete electronic documents and obsolete legislation is not retained
- Printed QMS documents that are obsolete are promptly removed from use by QC and replaced by current printed versions
- QC writes or stamps 'obsolete' on hard copies of obsolete QMS documents and files in QC office or in the Plan Room, as designated by the QC
- After approximately two years in the QC Office or Plan Room, QC may move obsolete documents to a designated storage area for archiving
- Currently, obsolete QMS documents are retained indefinitely

Protecting Documents From Damage

- Hard copies of documents are stored in file cabinets or in banker's boxes, in allocated file storage areas
- All electronic QMS documents reside on the central network drive
- Network is automatically backed up at the Plant and centrally at the headquarters of the Operating Authority
- Backup is performed daily and the backups maintained for a period of approximately four weeks less one day

MSDS Documents

- MSDSs are controlled under the QMS due to their importance in Emergency Preparedness
- MSDSs are forwarded to the QC
- The QC files MSDSs in the master binder located outside of the control room, and copies relevant MSDSs to other workstations as required
- QC is responsible for ensuring the proper maintenance of MSDSs
- Obsolete MSDSs are not retained

Filing of Records

- Hard copies of Operator's records, excluding log books, are filed by Operators in appropriate file cabinet in Control Room
- Monthly, the QC moves operators records to the Plan Room (except Log Books – they remain in the Control Room indefinitely)
- Records of government Compliance reports are filed at the Plant
- Records of Engineer's reports are filed with the Owner
- Training records are filed by the Administrative Assistant at Plant in personnel files
- Relevant training certificates are posted in the control room
- Work orders, which are records of maintenance, are filed electronically in the maintenance system
- All other QMS records are filed in the QC's office
- All paper copies are properly stored (clean, dry, organized)

Special Requirements For Log Books

- Logs and other record-keeping mechanisms must be used according to requirements in O.Reg. 128/04 – Certification of Drinking-Water System Operators and Water Quality Analysts, including:
- Making chronological entries
- Ensuring entries are only made by authorized personnel
- Authorized personnel identifying themselves as the maker of the entry
- Recording information concerning dates, times, shifts, operator on duty, departures from procedures, special instructions, abnormal conditions, and equipment taken out of service
- Filing of log books, by Operators in appropriate file cabinet in Control Room

Retention Of Records

- QMS Records are retained indefinitely
- In case of future changes, the following records have **minimum legislated retention** times, which are the responsibility of the Owner of the LHPWSS to maintain:

<u>Record Minimum Retention Time</u>

- Annual reports prepared by the Owner - 5 years
- Log books and other record-keeping mechanisms as per O.Reg. 128/04 - 5 years
- Owner's Operations Reports to MOE - 5 years
- Owner's Engineer's Reports to MOE - 5 years
- Lab analyses of water samples for aluminum, chloramine, chlorine residual, fluoride, turbidity, or accredited lab reports - 15 years
- Waste Manifests - 2 years

Electronic Records

- Electronic QMS records reside on the central network drive
- Electronic Maintenance records reside on the maintenance system
- Network is automatically backed up at the Plant
- Network backup and maintenance system backup is performed daily and is archived for a period of approximately four weeks less a day

SCADA Records

- The data collected through the SCADA system is backed up electronically
- The SCADA data is backed up through the Owner's server
- The SCADA electronic backup records are retained on the server for at least one year

Table of Revisions
Date, Description of Revision
October 6, 2006 - Initial Issue of Document

PART III of III

Model Operational Plans

Note: The model operational plans provided are a guide providing examples of types of documents that may be submitted. Some model operational plans refer to procedures that are not included in the operational plan document.

Model Operational Plan - A

Description

A surface water supply system with a treatment plant and distribution network.

Ownership

The system is owned by the municipality.

Operating Authority

The operating authority is St. Joseph Utilities.

Note: **Some procedures referenced in the following operational plan may not be included.**

St. Joseph Water Supply System
DOCUMENT TITLE: Operational Plan Manual
QMS REFERENCE: N/A
TO BE REVISED: Annually or when QMS changes
QMS REPRESENTATIVE:

Quality Management System

Operational Plan

St. Joseph Water Supply System

1234 St. Joseph, Ontario

Table of Contents

List of Appendices

1 Introduction

Quality Management can be defined as the policy and associated organizational structures, procedures, responsibilities, and evaluation measures that ensure the capability of delivering a product to specified standards. The use of Quality Management systems by modern industry has steadily increased over the last 30 years, since the development of the first ISO standard in 1986. Whether implemented voluntarily or as a requirement of suppliers to larger manufacturers, Quality Management has repeatedly proven beneficial in terms of accountability, quality control, efficiency, and productivity.

Although historically used on a voluntary basis by some progressive water utilities, the idea of mandated province-wide implementation of a Quality Management Standard by drinking water system owners originated as a recommendation in the Part Two Report of the Walkerton Inquiry. In brief, Recommendations 51 through 57 from the report state the following:

- Drinking water systems should be operated by authorities that are accredited based on successful third party audits conducted by a certified accrediting body.
- The Ministry of the Environment, in partnership with other relevant stakeholders, should develop a Drinking Water Quality Management Standard against which the third party audits will be conducted.
- All municipalities should prepare Operational Plans describing how the requirements of the Quality Management Standard are achieved.

The Provincial Government has committed to implementing all recommendations tabled by the report author, The Honourable Dennis R. O’Connor.

In accordance with those recommendations, this Operational Plan serves as a Quality Management System Guidance Manual that describes the methods by which St. Joseph Utilities implements Quality Management. The Plan is written to meet or exceed the requirements of the Ministry of the Environment prescribed standard and is applicable to the management and operation of those works described in Section 6 of this Plan.

2 Quality Management System Policy

St. Joseph Utilities (SJU), on behalf of the Town of St. Joseph, is committed to supplying a safe, consistent, drinking water supply while maintaining strict adherence to all applicable legislative and regulatory requirements. We strive to achieve these goals through the implementation of a management system comprised of policies, procedures, instructions, and forms that demonstrate risk-based treatment process evaluation, staff competency, open communications, workplace safety, and appropriate contingency / incident response measures.

The managers and employees of SJU who are directly involved in the supply of drinking water, share in the responsibilities of implementing, maintaining, and contributing to the continual improvement of the Quality Management System.

3 Commitment and Endorsement

The system owner, the Town of St. Joseph, and the operating authority, the St. Joseph Water Supply Utilities Commission, support the implementation, maintenance, and continual improvement of a drinking water Quality Management System (QMS) for the St. Joseph Water Supply System, as documented in this Operational Plan. Endorsement by the owner, (represented by the Town of St. Joseph Clerk-Administrator), and top management, (represented by the SJU General Manager and SJU Commission Chair), acknowledges the need for, and supports the provision of sufficient resources to maintain and continually improve the QMS.

The Designated QMS Representative and alternate, appointed by SJU Top Management, acknowledge the roles and responsibilities of that appointment.

Date	Town of St. Joseph Clerk-Administrator John Millar, BA, CMO
Date	St. Joseph Utilities Commission Chair Bruce MacDonald
Date	St. Joseph Utilities General Manager Susan Wentworth, P.Eng.
Date	Designated QMS Representative Wendy Clark
Date	Designated QMS Representative (alternate) Bill Turner

4 QMS Representation

Designated QMS Representative and Committee Participants

Title	QMS Roles
Designated QMS Representative (Manager of Operations)	▪ promotes awareness of the QMS throughout SJU and reports QMS results to SJU staff ▪ ensures QMS documentation is prepared and maintained, as needed ▪ provides all staff with technical and administrative consultation related to QMS document preparation and implementation, as needed ▪ reviews and approves QMS documentation ▪ implementation and oversight of document control procedure ▪ internal auditing, and external audit liaison ▪ staff and supplier QMS communications and training ▪ reporting of QMS results to top management, and any need for improvement ▪ ensures that personnel are aware of all applicable legislative and regulatory requirements that pertain to their duties for the St. Joseph Water Supply System
Designated QMS Representative alternate (Documentation/Process Technician)	▪ performs all roles of Designated QMS Representative, with the exception of document approval
SJU General Manager	▪ appoints QMS Designated Representative and alternate ▪ provides technical and administrative consultation related to QMS document preparation ▪ reviews and approves QMS documentation ▪ endorses QMS as Top Management representative
Head Operator, Facilities Operators, and Operator / Maintainers	▪ assists with QMS technical document preparation ▪ provides technical and risk assessment consultation to others preparing QMS documentation ▪ maintains awareness of Operational Plan requirements and consistently implements the QMS at the treatment facilities

5 QMS Document and Records Control

Details regarding QMS document identification, retention, storage and disposal are contained within the Document Control Procedure, attached as **Appendix A**. QMS records are retained according to the Record Control Procedure attached as **Appendix B**.

6 Drinking Water System Process Description

General

The St. Joseph Water Supply System provides a potable water supply to the residents and businesses of the Town of St. Joseph. The facilities, consisting of a Class III conventional design water treatment plant having an approved capacity of 10,450 m^3/d, and a Class II water distribution system, are owned by the Town of St. Joseph and operated by the St. Joseph Utilities (SJU).

The source water for the treatment process is drawn from a surface water source (Lake St. Joseph) located approximately 5 km south of the town. Potentially pathogenic organisms are removed from the raw water source by the following processes:

1. Pre-chlorination
2. Coagulation / flocculation / sedimentation
3. Filtration
4. Post-chlorination (primary disinfection)
5. Distribution system chlorine residual (secondary disinfection)

This multiple barrier approach helps to ensure consistently compliant drinking water quality, and ultimately improves the level of public health protection.

Raw Water Supply

Water is drafted from Lake St. Joseph and pumped through a 500mm pipeline to reservoirs located at the northeast corner of County Road 12 (Main Street) and Big Hill Road. Sodium hypochlorite is added at the water intake for zebra mussel control and to provide initial disinfection. The addition of sodium hypochlorite to the raw water supply is referred to as pre-chlorination, and serves primarily as a measure to prevent microbiological growth within the raw water pipeline and reservoir. The pre-chlorine residual is measured continuously in the raw water entering the treatment facility.

Coagulation / Flocculation / Sedimentation

Water flows by gravity from the raw water reservoir through two 150 mm electrically actuated valves to the water treatment plant. Alum (hydrated aluminum sulphate) is added to the incoming raw water upstream from the flocculation basin to promote settling and enhance

filtration. Rapid mixing of the alum with the raw water occurs as the raw water passes through an in-line static mixer. The alum-water solution enters a baffled flocculation basin where gentle mixing promotes the formation of floc masses which attract and gather debris present in the source raw water. The process water then flows into sedimentation tanks where the floc is provided sufficient detention time for settling. Supernatant (the clear liquid above the settled floc) overflows the sedimentation tank effluent weir to the top of the dual media filters.

Most of the particulate matter that was present in the raw water is captured by the floc particles and removed by gravity in the sedimentation tanks, however, during normal operations, some floc passes from the sedimentation tanks to the top of the filters.

Filtration

The water treatment plant has two parallel dual media filters. The top layer of the filter is granular activated carbon (GAC), while the filter media below the GAC layer is sand. The GAC is effective in removing organic compounds, many of which are responsible for unpleasant taste and odour sometimes experienced during the warmer months. Residual particulate matter (floc) carried over from the sedimentation process is trapped primarily in the sand portion of the filter. As debris accumulates in the filters and limits flow, the filters must be cleaned by reversing the flow (referred to as backwashing) and directing the backwash to a waste holding tank.

Turbidity, a measure of the cloudiness of water, is measured continuously in the effluent from each filter to monitor the effectiveness of the filtration process. If the turbidity rises above a set point value, an alarm warns staff that corrective actions are needed.

Filtered water passes through the filter under-drain into the treated water clearwells. The clearwells are baffled tanks located beneath the filters that are used to store filtered water and to provide disinfectant contact time.

Disinfection (Chlorination)

Primary disinfection (post-chlorination) occurs following filtration, immediately upstream from the treated water clearwells. Primary chlorination disinfects the filtered water, ensuring that any potentially pathogenic organisms that may remain after sedimentation and filtration are rendered harmless prior to distribution to consumers. Consistent disinfection is ensured by continuous monitoring of the chlorine residual in the treated water leaving the facility. If the residual drops

below a safe level, pumping to the distribution system is automatically interrupted and an operator is notified to correct the problem.

Secondary disinfection is accomplished by adding sufficient chlorine at the water treatment plant to maintain a residual throughout the entire distribution system. Secondary disinfection prevents regrowth of micro-organisms within the distribution system.

Process Waste Residuals Management

Filter backwash water and accumulated alum floc from the sedimentation tanks are directed to an equalization tank from where they are pumped to a residuals thickening process. The sludge collected within the thickening process is pumped to the municipal sanitary sewer. The clarified effluent from the thickener is de-chlorinated and discharged back to Lake St. Joseph.

Distribution System and Elevated Storage Tank

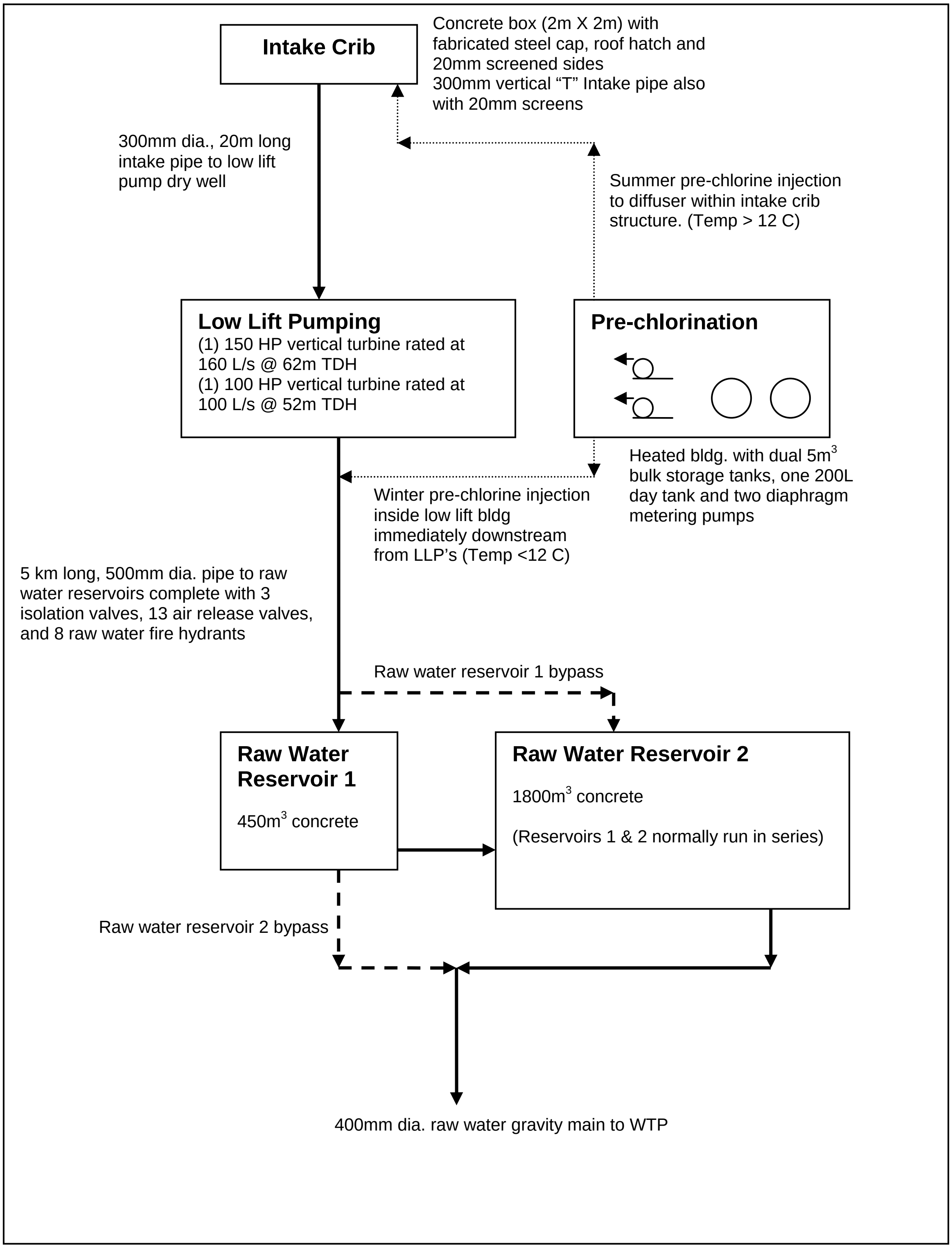
Treated water is pumped from the clearwells into the distribution system. Distribution piping typically ranges in size from 150 mm to 250 mm, and may consist of cast iron, ductile iron, concrete, or PVC, depending on the location and date of installation. Two pressure booster stations, (one at the south end of town on Park Street and the other at the north end of town on Church Street), are used to ensure adequate system pressure in areas of higher elevation or locations significantly removed from the plant and elevated storage tank. Typical system pressure ranges from 45 P.S.I. to 80 P.S.I. The elevated storage tank is an integral component of the distribution system. The purpose of the storage tank is to provide relatively constant system pressure and a reserve volume of water for community fire protection.

Sample Analysis

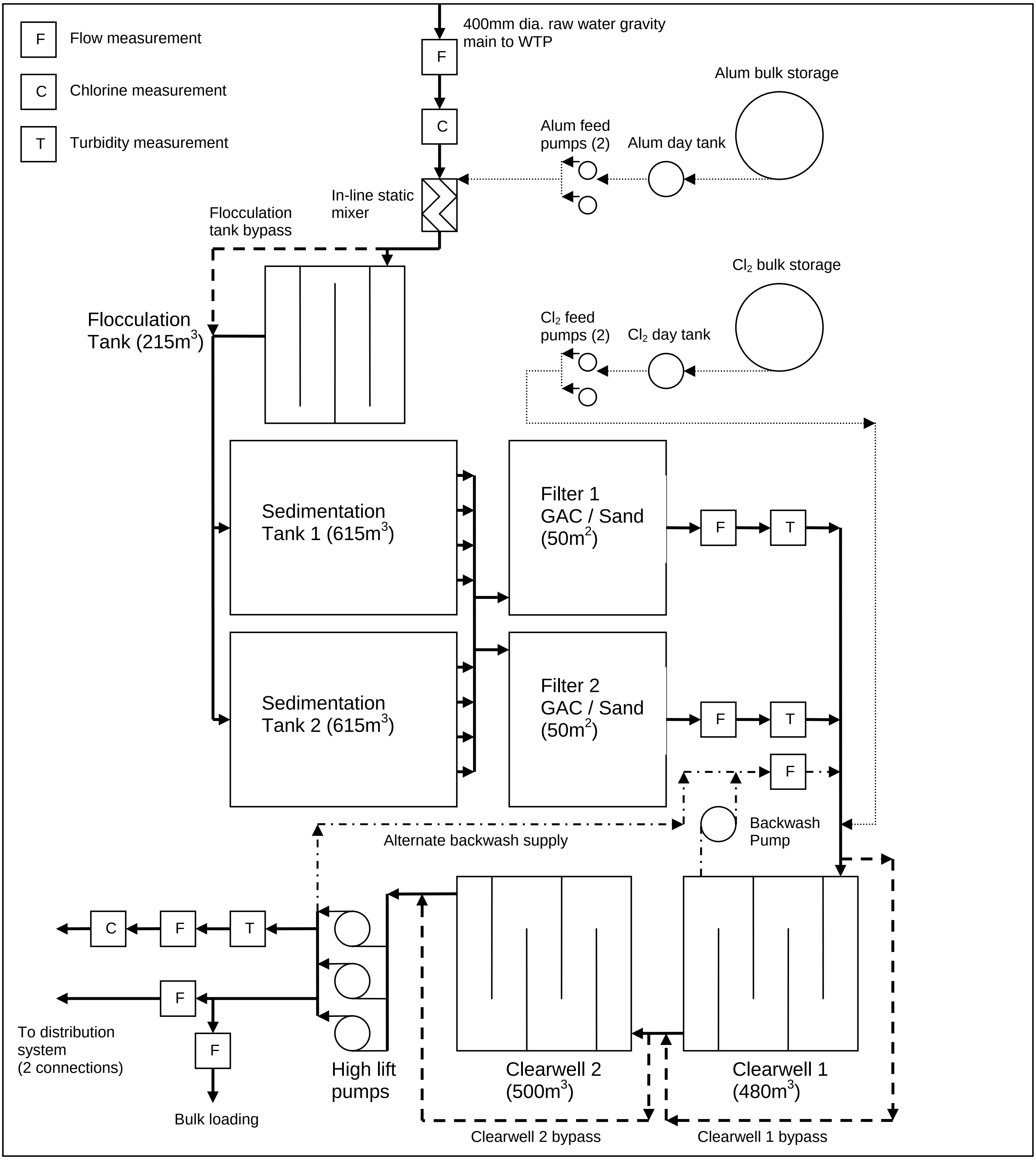
Provincial regulations dictate the sampling and monitoring requirements for the system. Water quality is tested throughout the treatment process and from dedicated sampling hydrants located at the extremities of the distribution system. Where required by regulation, samples are submitted to an accredited laboratory for analyses.

6.1 Drinking Water System Process Diagrams

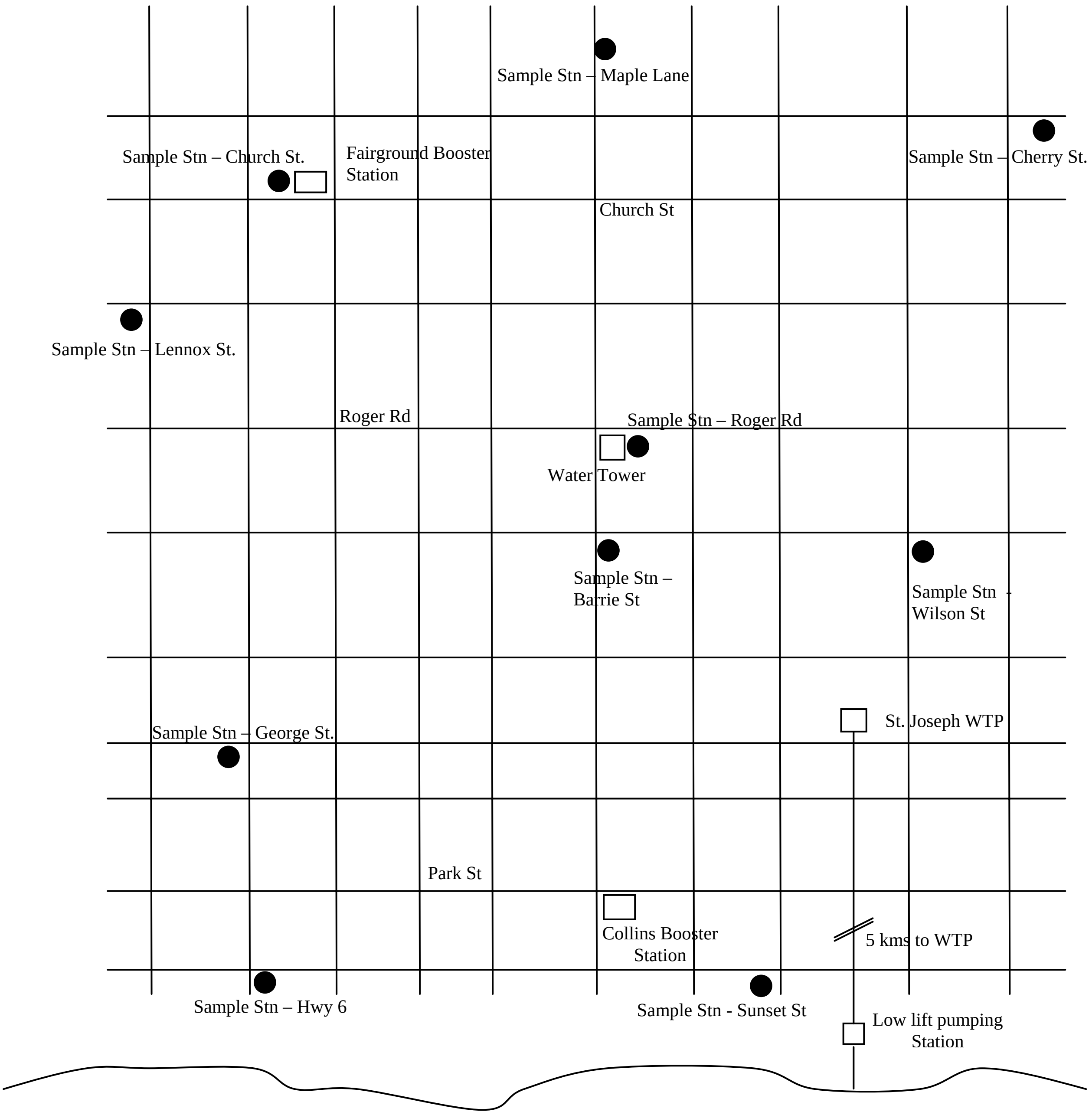
St. Joseph Water Supply System – St. Joseph Raw Water Transmission



St. Joseph Water Treatment Plant



St. Joseph Water Distribution System



6.2 Source Water Overview

General

The raw water source for the treatment plant is Lake St. Joseph. The water from Lake St. Joseph is typically very low in turbidity (<1 NTU), low in colour, slightly basic, and marginally hard (~120mg/L as $CaCO_3$). Temperature fluctuates significantly throughout the seasons ranging from approximately 4 Celsius in the winter to as high as 25 Celsius during the summer. Chemical and bacteriological analysis of the raw water indicates a source of relatively good quality.

Events

Seasonal changes in raw water temperatures cause vertical turnover of the lake water during spring and fall. Turnover typically takes place over a relatively short duration (~2 – 7 days). During that period, settled solids from the lakebed are re-suspended, resulting in increased raw water turbidity. Operators must be prepared to make appropriate plant adjustments to treat the elevated levels of turbidity experienced during turnover events.

Changes in water temperature will also impact treatment process performance (settling and disinfection). Optimal treatment requires timely adjustments to treatment chemical dosages (disinfectants and coagulants) in response to temperature fluctuations.

Threats

Potential sources of raw water contamination include agricultural runoff, spills from nearby highway traffic mishaps and waste from recreational watercraft.

The Lake St. Joseph intake pipe is only 20 m offshore, at a depth of less than 5 m to the top of the crib. Due to the shallow positioning of the crib, the intake is susceptible to potential accidental damage from marine craft or ice, and is also vulnerable to intentional acts of vandalism or contamination.

Some risk of plugging of the intake screen by Zebra Mussel growth or from other debris in the water also exists.

Operational Challenges

Lake St. Joseph provides high quality source water, which is, for the most part consistently low

in bacteriological contamination and turbidity. While operator response is needed for events of elevated turbidity and temperature changes, the most significant challenge related to the source water is the 5 km pipeline through which the water is transported to the treatment facility. Only one pipe exists, which means repairs to pumping equipment or the pipeline itself results in an interrupted supply to the treatment facility. It is essential that the communications and monitoring equipment from the remote low lift pumping station and raw water reservoir remain in good working order so that problems are identified quickly. Preventive and breakdown maintenance is carefully planned to minimize the interruption to raw water supply.

7 Risk Assessment

The procedure entitled Hazard Analysis, attached as **Appendix C**, describes the method of hazard identification, risk assessment, and critical control point determination for the St. Joseph Water Supply System. The procedure consists of four main exercises: hazard identification, risk assessment, critical control point determination, and critical limit identification.

8 Risk Assessment Outcomes

The following table documents the initial hazard identification exercise conducted for the St. Joseph Water Supply System. All hazards were identified and categorized according to the Hazard Analysis procedure.

Summary and Classification of Identified Hazards

Hazard	Emergency (Contingency)	Operational (Instructions)	Measurable (Yes/No)	Comments/ Control Measures
Spill of biological or chemical material into Lake St. Joseph	X		-	Alternate Source
Low lift pump failure (x1) – electrical/mechanical		X	Y	Redundancy
Low lift pump failure (x2) – electrical/mechanical		X	Y	Alternate source
Low lift discharge valve failure – electrical/mechanical		X	Y	
Pre-chlorination pump failure – electrical/mechanical		X	Y	Redundancy
Break in pre-chlorination pipe		X	Y	
High concentration pre-chlorine		X	Y	
Break in raw water main	X		-	
Power outage at reservoir		X	N	Work order required
Mechanical failure of raw water valves/air compressor		X	Y	Redundancy/Manual
Failure of bulk alum storage tank	X		-	Spills Contingency
Failure of coagulant pump – electrical/mechanical		X	Y	Redundancy
Overdosing/under dosing coagulant		X	Y	Not hazardous
Break in coagulant lines		X	Y	
Blockage of static mixer	X		-	Work order required
Loose baffle curtains in coagulation basin	X		-	
Failure of sludge vac system – electrical/mechanical		X		No effect on quality
Turbidimeter malfunction	X		-	
Filter underdrain failure	X		-	Redundancy/replacement
Failure of backwash pump – electrical/mechanical		X	N	Alternate backwash
Failure of filter valves – electrical/mechanical		X	Y	
Filter breakthrough		X	Y	
Failure of post chlorine pump – electrical/mechanical		X	Y	Redundancy
Break in post chlorine lines		X	Y	
Failure of post-chlorination electrical controls		X	Y	Redundancy
Overdosing/under dosing post chlorine		X	Y	
Cross-contamination from clearwell to equalization tank	X		-	Work order required
High lift pump failure (x1) – electrical/mechanical		X	Y	Redundancy
Air locked high lift pump		X	Y	Redundancy
Pressure relief valve failure		X	N	
Break in high lift pump coolant lines	X		-	Work order required
Low pressure in distribution system		X	Y	
Operating without tower	X		-	operate w/o tower
Access to hydrants not restricted	-	-		Bylaws
Security – vandalism, tampering		X	Y	
Failure to receive a critical supply		X	Y	
General power outage	X		-	Diesel generators
Alarm failure	X		-	reg. insp./ fibreoptics
SCADA failure	X		-	Redundancy
Failure of backflow prevention device	X		-	Annual inspection

The initial risk assessment and critical control point determination exercises, also described in the Hazard Analysis procedure are recorded in the following table.

Summary of Risk Assessment and Critical Control Point Determination

Process Step	Description of Hazard	Result	Available Control Measures	Detectability	Severity	Likelihood	Total	Critical
Raw Water	Low lift pump or discharge valve failure (mech. or elec.)	Loss of lake raw water source	Redundancy; preventative maintenance; daily inspections	1	1	3	3	No
Pre-chlorination	Cracking, crushing or blockage of pre-chlorination pipe	Zebra mussel build up causing blockage of raw water intake	Annual inspections	4	1	2	8	No
	Chemical feed pump failure (mech. or elec.)	Zebra mussel build up causing blockage of raw water intake	Redundancy; preventative maintenance; daily inspections	1	1	1	1	No
	High chlorine concentration	Trihalomethanes	Daily inspections (calculate dosage and analyze residual)	1	3	1	3	No
Raw Water Valves	Valve failure (remaining open or closed)	Plant flooding; loss of lake raw water source	Redundancy; ability to operate manually	1	2	3	6	No
Coagulant Dosing	Coagulant Interruption	Increased turbidity	Daily inspections (calculate dosage and analyze residual); redundancy	3	3	2	18	Yes
Filtration	Filter breakthrough	Increased turbidity	Redundancy; regular backwashes	3	3	2	18	Yes
	Filter valve failure (mech. or elec.)	Valves must be operated manually to filter water	Redundancy	2	2	2	8	No
Post-chlorination	High chlorine concentration	Health hazard if beyond upper limit	Daily inspections (calculate dosage and analyze residual)	1	3	2	6	No
	Low chlorine concentration	Inadequate disinfection	Daily inspections (calculate dosage and analyze residual)	1	4	3	12	Yes
Distribution	High lift pump failure (mech. or elec.)	Possible loss of system pressure	Redundancy; preventative maintenance	1	2	3	6	No
	Low pressure in distribution system	Contamination of drinking water	Tower and booster station alarms	1	5	2	10	Yes
Security	Vandalism; tampering	Contamination of drinking water; damage to process equipment	Alarms; locks; fencing where appropriate	1	4	1	4	No
Suppliers	Failure to receive a critical supply	Unable to treat water adequately	Written communications/agreements	1	4	1	4	No

Controlled Conditions for Critical Control Points

Controlled conditions for each critical control point identified in the summary table are described in detail in the following sets of instructions:

Filter Effluent Turbidity Critical Limit Response, attached as Appendix D

Primary Disinfection Critical Limit Response, attached as Appendix E

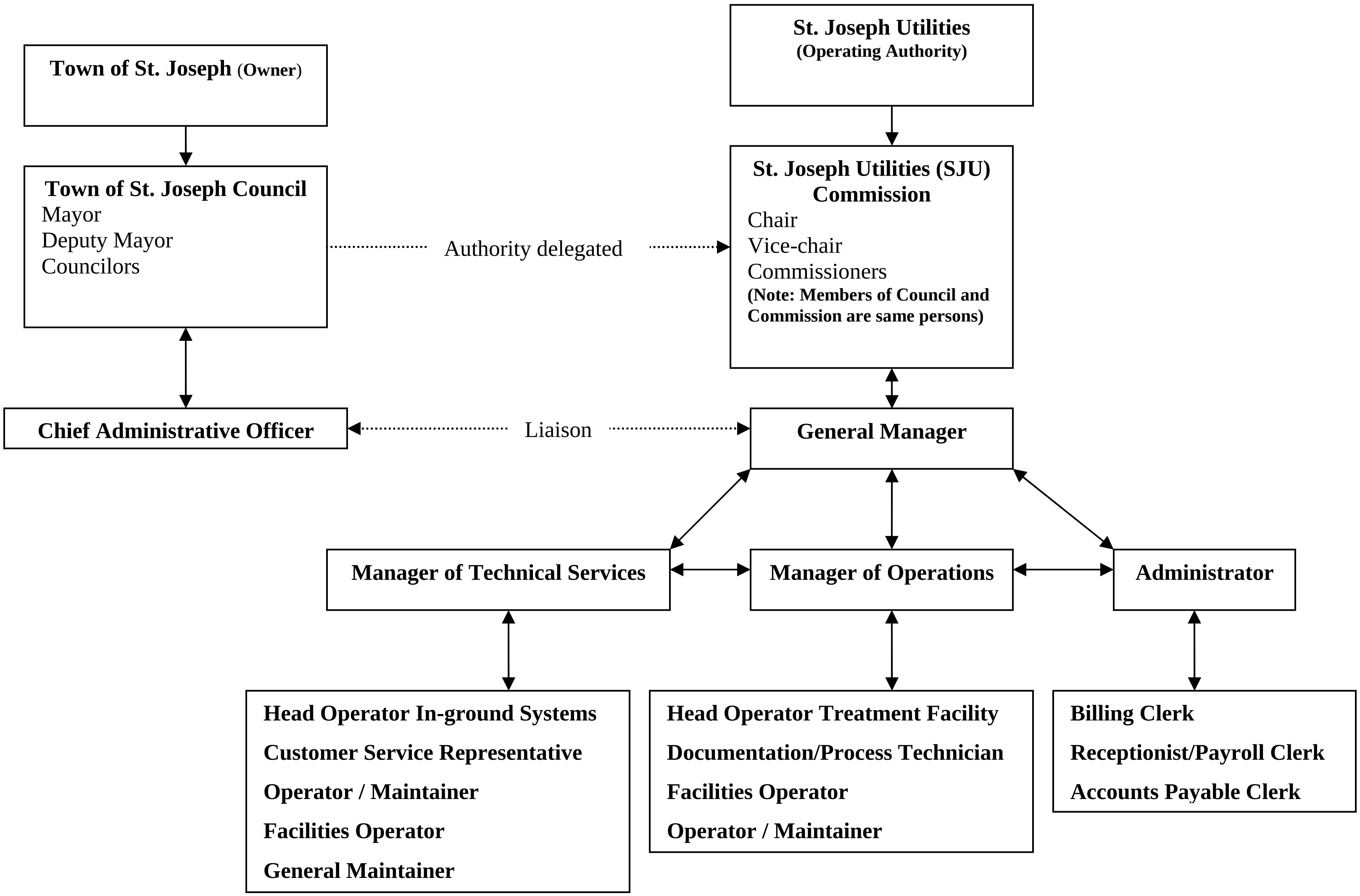
Distribution System Pressure Critical Limit Response, attached as Appendix F

Secondary Disinfection Critical Limit Response, attached as Appendix G

In addition to a detailed response procedure, each instructional document includes the considerations and rationale for establishing the critical limits, as well as a listing of the operational safeguards currently in place to prevent a breach of the critical limit.

9 Organizational Structure, Roles, Responsibilities and Authorities

Organization Chart



Town of St. Joseph Council and Staff (owner)

Responsibilities	**Authorities**
In addition to ensuring the provision of safe and reliable municipal water supply to the serviced areas of the Town of St. Joseph, the owner is also responsible for: ▪ municipal bylaw enforcement ▪ municipal taxation ▪ building permits and inspection ▪ planning ▪ public works (roads and storm sewers), ▪ parks and recreation ▪ fire services ▪ endorsing the QMS for the St. Joseph Water Supply System.	On behalf of the electorate of the Town of St. Joseph, the owner is authorized to: ▪ manage or delegate management of utility assets ▪ review, revise and approve proposed and existing bylaws, expenditures, user fees, and taxation rates ▪ provide / review / approve administrative policy direction ▪ hire, discipline or terminate Town staff or contracted service providers.

St. Joseph Utilities Commission (operating authority)

Responsibilities	**Authorities**
The Commission is delegated by the respective system owners the responsibility of providing safe, compliant, and reliable water services to properties in the Town of St. Joseph that are connected to the municipal treatment system. Commission responsibilities include safety, fiscal responsibility, and compliance with all applicable legislation. The Commission is also responsible for endorsing the ongoing development of the QMS for the St. Joseph Water Supply System and for undertaking the Management Review of the QMS.	Authorities delegated to the Commission by the owner include: ▪ approval of expenditures and user fees ▪ to provide / review / approve SJU administrative policy direction ▪ to hire, discipline, or terminate utility management staff

St. Joseph Utilities Administration and Temporary Staff

The following roles do not impact drinking water quality and therefore have no responsibilities or authorities under the scope of the QMS: Receptionist, Payroll Clerk, Billing Clerk, Accounts Payable Clerk, Administrator, General Maintainer, as well as temporary staff including summer students and others hired to perform general labour.

General Manager (top management)

Responsibilities	Authorities
The General Manager is responsible for ensuring safe, reliable, and compliant operation of all systems under the responsibility of the Commission. The General Manager is also responsible for: ▪ preparing budgets ▪ maintaining communications with the Commission ▪ communicating with the owner, the public, regulatory authorities, other utilities, and various professional organizations on behalf of the Commission ▪ advising the Commission on water policies and bylaws ▪ providing direct supervision of all utility management staff ▪ undertaking the Management Review of the QMS	The General Manager is authorized by the Commission to: ▪ evaluate and prioritize long-term utility needs ▪ prepare, review, and approve design specifications ▪ select contractors and equipment ▪ develop and implement administrative and technical policy ▪ hire, discipline, or terminate management and union staff ▪ communicate with regulatory agencies, public, and owner on behalf of the Commission

Manager of Operations (see also Operator)

Responsibilities	Authorities
In addition to the responsibilities of the Designated QMS Representative defined in the Standard, the responsibilities of the Manager of Operations include: ▪ evaluation and optimization of treatment process operations to provide safe, compliant, reliable water services ▪ regulatory reporting ▪ assisting General Manager with budgeting and long-term planning ▪ reporting operating conditions and activities to the General Manager, the Commission, the owner, members of the public, and regulatory authorities ▪ supervision and providing technical direction to operations staff ▪ the duties of General Manager, in his absence.	The Manager of Operations is authorized by the Commission to: ▪ develop, approve, and implement standard safety and operating strategies / policies and procedures ▪ communicate with regulatory agencies, public, and owner on behalf of the Commission ▪ evaluate and prioritize long term treatment process needs ▪ participate in hiring and discipline of union staff ▪ review and provide comment on technical reports and proposals ▪ evaluate and select appropriate process equipment and treatment chemicals ▪ approve payment for goods and services received

Manager of Technical Services (see also Operator)

Responsibilities	Authorities
The Manager of Technical Services is responsible for: ▪ maintenance of the of the water distribution system ▪ supervision and providing technical direction to maintenance staff ▪ preparation and supervision of contracts for distribution system repair / replacement / rehabilitation as well as for major plant equipment repair or installation ▪ reporting maintenance activities to the Manager, the Commission, and to the owner, members of the public, and regulatory authorities on behalf of the Commission ▪ assisting the General Manager with budgeting and long-term planning ▪ regulatory reporting	The Manager of Technical Services is authorized by the Commission to: ▪ develop, approve, and implement maintenance and safety practices / policies and procedures ▪ communicate with regulatory agencies, public, and owner on behalf of the Commission ▪ inspect and approve in-ground water infrastructure installations and repairs ▪ evaluate and prioritize long-term rehabilitation and upgrading needs ▪ participate in hiring and discipline of union staff ▪ review and provide comment on technical reports and proposals ▪ evaluate and select contractors, construction materials, and maintenance equipment ▪ approve payment for goods and services received

Head Operator (see also Operator)

Responsibilities	Authorities
The responsibilities of the Head Operator include: ▪ ensuring the collection of operating data, and providing reports to the Manager of Operations ▪ directing and reviewing (in terms of quality and safety) the activities of operators and contractors ▪ maintaining provincial licensing at a classification level at least equivalent to the class of the system ▪ reporting and coordinating maintenance activities ▪ maintaining currency of documents in accordance with QMS policy	The authorities of the Head Operator include: ▪ instructing other operators to make necessary process adjustments ▪ ordering required process chemicals, lab supplies, analytical services, and equipment replacement parts ▪ assigning duties to other on-site union operators ▪ supervising work (quality and safety) of operators and on-site contractors ▪ authorities defined for Operator

Documentation / Process Technician (see also Operator)

Responsibilities	Authorities
The responsibilities of the Documentation / Process Technician include: ▪ preparation and revision of technical operational documentation including O&M Manuals, Operational Plans, and PM Program ▪ preparation of technical and training summary reports for Management ▪ issuing PM work orders ▪ maintaining employee training records ▪ acting as alternate to the Designated QMS Representative	The Documentation / Process Technician is authorized to: ▪ review and revise O&M Manuals, Operational Plans, and PM Program (management approval of final revisions required) ▪ remove obsolete documentation or implement new documentation for any system in accordance with the Document and Records control procedures ▪ access and collect any operational or maintenance data required for document preparation or summary reports to managers

Operator / Maintainer (see also Operator)

Responsibilities	Authorities
Operator / Maintainer responsibilities include: ▪ PM checks of electro-mechanical process equipment ▪ measurement and recording equipment calibration and maintenance ▪ performing maintenance duties in accordance with applicable technical and safety codes of practice ▪ installation and repair of electronic, and electro-mechanical equipment	The Operator / Maintainer is authorized to: ▪ install, repair, or replace any electronic, electrical, or mechanical equipment if qualified and approved by management ▪ arrange for, direct, and supervise the services provided by specialty contractors when needed

Customer Services Representative *(see also Operator)*

Responsibilities	**Authorities**
The responsibilities of the Customer Services Representative include: ▪ acting as primary contact for investigation and response to customer complaints ▪ preparation, revision, and maintenance of all SJU engineering drawings in both electronic and hard copy format ▪ maintain library of all SJU engineering drawings ▪ locate and document water service locations for SJU, public, and other agencies	The Customer Services Representative is authorized to: ▪ make appointments with customers, contractors, and other agencies to investigate complaints, and to locate utility services ▪ inspect and approve in-ground water infrastructure installations and repairs ▪ prepare, revise, and store all SJU engineering drawings as directed by management

Facilities Operator *(see Operator)*

Operator *(including: Head Operator, Documentation/Process Technician, Facilities Operator, Operator Maintainer, Customer Services Representative, Manager of Technical Services, and Manager of Operations)*

The above positions share common responsibilities and authorities as licensed operators:

Responsibilities	**Authorities**
Responsibilities shared by all licensed operators include: ▪ monitoring, maintaining, and adjusting systems in accordance with industry standards and SJU procedures to meet or exceed regulatory standards and internal performance goals ▪ collecting samples and performing or arranging laboratory testing in accordance with legislation ▪ reporting and acting on incidents of emergency and non-compliance ▪ maintaining provincial operator licensing for all SJU systems ▪ recording operating activities in the applicable log or form in accordance with legislation and SJU policies	Licensed Operators are authorized to: ▪ make process adjustments based on SJU policies and professional judgement to maintain compliance with legislation and to achieve SJU performance goals ▪ collect samples and perform routine laboratory analyses ▪ make entries of operating events in log books and standard forms ▪ report incidents of non-compliance to management and appropriate regulatory authorities ▪ act as Overall Responsible Operator if designated by management ▪ supervising work (quality and safety) of on-site contractors

10 Competencies

The following table lists the minimum levels of competencies required of trained SJU staff whose performance may have a direct impact on drinking water quality.

Notes: - Roman numerals denote required operator certification - "0" indicates competency not required - "1" indicates basic level of competence - "2" indicates intermediate level of competence - "3" indicates advanced level of competence	Owner / Operating Authority	General Manager	Manager of Operations	Manager of Technical Services	Head Operator (WTP)	Head Operator (Distribution)	Documentation / Process Tech.	Operator / Maintainer	Facilities Operator	Customer Services Rep.
Supervisory Skills	0	3	3	3	2	2	1	1	1	1
Presentations / Training	0	3	3	3	2	2	2	1	1	1
Verbal Communications	1	3	3	3	2	2	2	1	1	2
Written Communications	1	3	3	3	2	2	2	1	1	1
Technical Writing	0	3	3	3	2	2	2	1	1	1
Research Skills	1	3	3	3	1	1	2	1	1	1
Budget Preparation / Analysis	2	3	2	2	1	1	0	0	0	0
Long-term Planning	1	3	2	2	1	1	0	0	0	0
Scheduling / Work Planning	0	3	3	3	2	2	1	1	1	1
Contract Management	1	3	2	3	1	1	0	0	0	0
Record Keeping	0	3	3	3	2	2	2	2	2	2
Regulatory Requirements	1	3	3	3	2	2	2	2	2	2
Emergency Procedures	1	3	3	3	2	2	2	2	2	2
OETC WT Certification	0	0	III	III	III	I	I	I	I	I
OETC WD Certification	0	0	II	II	I	II	I	I	I	I
Water Treatment Unit Processes	1	2	3	2	2	2	2	1	2	2
Process troubleshooting	0	2	3	2	2	2	2	2	2	2
Technical mathematics	0	3	3	3	2	2	2	2	2	2
Chemistry	0	3	3	2	2	1	2	1	2	1
Biology	0	3	3	2	2	1	2	1	2	1
Fluid Mechanics	0	3	3	3	2	2	2	2	2	2
Laboratory techniques	0	2	2	1	2	1	2	1	2	1
Sampling / preservation	0	2	2	2	2	2	2	2	2	2
Pumps / valves / piping maintenance	0	2	2	3	2	2	1	2	2	1
Electrical instrumentation / controls	0	2	2	3	2	2	1	2	1	1
Motor controls	0	2	2	3	2	2	1	2	1	1
Interpreting plans / blue-prints	0	3	3	3	2	2	2	2	2	2
Computer - spreadsheets and word processing	0	2	2	2	2	2	2	1	1	1
Computer aided design	0	1	1	2	1	1	1	0	0	2
SCADA	0	2	2	2	2	1	1	2	1	1

IMPORTANT NOTE – different competencies are not considered equivalent, therefore cumulative totals are not appropriate for overall skill level comparison

Levels of Competency

The competency identification table on the previous page indicates the skill level required for each position whose actions may have a direct impact on water quality.

At competency Level 1, a basic, theoretical level of understanding is required. Level 1 understanding is normally acquired through a combination of theoretical instruction, on-the-job training, review of journal articles, and specialty seminar attendance.

Level 2 indicates an intermediate, theoretical and working knowledge of a skill, typically acquired through post-secondary theoretical and practical instruction, on-the-job experience, and participation in specialty workshops and courses.

Level 3 indicates advanced theoretical and working understanding of a particular subject area, particularly as it pertains to the person's responsibilities in the water treatment process. Level 3 is achieved through a combination of successful completion of a post-secondary degree or diploma in engineering, science, or technology, at least 10 years of directly related experience and training, as well as regular participation at specialty seminars and courses.

Satisfying Competencies

Identified competency requirements for SJU staff are satisfied by the following:

- Candidates considered for hire must submit proof of relevant post-secondary education and must demonstrate technical competency and communications skills to an interview panel of SJU staff.
- New employees undergo comprehensive on-the-job training at all facilities, conducted and documented by experienced staff. Training documentation is signed by the employee and trainer, acknowledging successful information transfer. Training files are maintained for all SJU staff.
- All employees receive a minimum of 40 hours training in various topics including safety, treatment process operations, contingency plans, regulatory requirements, equipment operation, and new technologies. The training is provided by experienced utility staff, technical experts, or contracted professional trainers. Training provision and certification levels meet or exceed those required by legislation.
- SJU provides incentive for staff wishing to upgrade their operating licenses as

remuneration increases with operator certification level. SJU covers the cost for examinations and license renewal.

- The SJU Commission members are briefed on operating conditions and provided regulatory updates at regular meetings with management staff. Commissioners are informed of training opportunities, such as relevant conferences and seminars.
- The owner is provided copies of Commission meeting minutes, all correspondence with the regulatory authorities, and annual operating reports.
- SJU provides funding to staff wishing to independently upgrade their education, provided the training is related to utility duties.

11 Personnel Coverage

SJU employs licensed operators, all of whom are required to hold operator certification for water treatment and water distribution. Several are also certified as Water Quality Analysts. Two of the licensed operators hold SJU management positions while the remaining are employed according to the terms and conditions of a collective agreement between SJU and the International Brotherhood of Electrical Workers. Unionized positions include: Head Operator, Facilities Operator, Operator Maintainer, Documentation/Process Technician, and Customer Services Representative, and Meter Reader / Maintainer. In the event of a union walkout, plant coverage will be provided by the licensed managers.

Summary Table of WTP Personnel Coverage

	Weekdays **(0730hr – 1600hr)***	**After Hours – all days** **(1500hr – 0830hr)***	**Weekends / Holidays** **(0730hr – 1600hr)***
Head Operator (permanent - 1)	X		
Facilities Operator (at least 1) **or** **Operator / Maintainer**	X		
On-call Duty Operator (1)		X	
Weekend Duty Operator (1)			X

*** Specified times are typical, however 8 hour day shift start and stop times may vary.**

One Head Operator is permanently designated as the Overall-Responsible-Operator (ORO) for the St. Joseph water treatment plant and for the distribution system. In the event of the absence of the Head Operator, alternate OROs are named on the inside cover of the facility logbook.

The Head Operator, under normal operating conditions, is assisted by one Facilities Operator or one Operator / Maintainer. SJU Facilities Operators or Operator / Maintainers are assigned duty rotations, typically for two or three month terms, and work under the direction of the Head Operator. The WTP is staffed in this manner on weekdays, typically between the hours of 0730 hr and 1600 hr.

Weekend and holiday shifts are covered by one of the licensed union operators on a rotating schedule. The weekend day shift operator is responsible for monitoring the Low Lift Pumping

Station, in addition to the WTP.

Off hours emergencies are addressed by the designated On-call Operator. All SJU operated facilities in the St. Joseph Water Supply System, are monitored by an alarm system, which sends a signal to the St. Joseph Fire Department dispatch office when alarm conditions are encountered. The Fire Department dispatcher then notifies the On-call Operator by telephone. The On-call Operator must be available by phone from one hour prior to the end of a day shift through to one hour after the beginning of the following day shift. Response to alarms must be within 30 minutes of receiving the call, in accordance with the union collective bargaining agreement.

One unionized operator is assigned to on-call duty according to a rotating schedule prepared annually and revised as needed by the Manager of Operations.

Rationale

One licensed operator is capable of completing all minimal weekend monitoring tasks at the water treatment facilities during routine operations. Similarly, most alarm conditions can be addressed by a single operator when following standard operational documentation. If circumstances arise where additional staff is required, the on-call operator can request the assistance of any of the other off-duty licensed operators. Contact information for all operators is documented in the on-call binder, readily accessible to the on-call operator.

The required emergency response time of 30 minutes is considered reasonable based on the extent of alarm coverage, conservative alarm set points, and the multiple monitoring and treatment barriers in place that prevent risk to public health.

12 QMS Communications

Target Audience	Method of QMS Communication
Owner – **St. Joseph Mayor & Council**	Internal and external audit results, Management Review results, and Operational Plan revisions / updates are provided in writing from the Designated QMS Representative to the St. Joseph CAO. Hard copies of all correspondence are retained in the SJU file registry in accordance with the records control procedure.
SJU Commission	Hard copies of any audit reports, Management Review results and Operational Plan revisions / updates are included within the written agenda for Public Utility Commission meetings. The QMS Representative is present at Commission meetings to supplement the hard copies with brief verbal presentations and to answer questions. Meeting minutes are archived in the SJU file registry.
SJU Staff	A formal presentation of the Operational Plan is provided each year to all staff. New permanent or temporary employees are provided an overview of the Operational Plan during orientation. Similarly, as substantial revisions / additions are required, or if audits have been conducted, a general staff meeting will be called to inform all staff of the changes or audit results. Details of QMS meetings will be documented in each staff persons training file. Minor modifications / revisions are communicated to staff by memorandum, copies of which are filed in the SJU file registry.
Critical Suppliers	An annual mailing is sent to all critical suppliers and service providers. The mailing includes a backgrounder describing the SJU QMS and also provides details of the Operational Plan, which relate directly to the relationship between the supplier and SJU. The QMS mailing would normally accompany an annual purchasing agreement.
Public	Bill stuffers and/or local newspaper advertising are used to communicate the QMS to SJU customers at least once each year. Details of the Operational Plan are also accessible on the SJU website.

The above table is also included in the SJU general Communications Procedure GEN-P9.

13 Essential Supplies and Services

Supply or Service	Primary Supplier	Contingency Supplier
Accredited Laboratory Services	MSG Bayfield 444 Lake Street Bayfield, ON (705) 555-2345	Maxxam 89A Fieldrow St. Ferguson Rapids, ON (705) 555-8900
Coagulant (Aluminum Sulphate)	Eaglebrook Inc. 3405 Blvd. Marie Victorin Varennes, QC 1-800-465-6171	ClearTech 1-800-387-7503 orders@cleartech.ca
Construction Contracting Services	TDS Construction Ltd. RR1, St. Joseph, ON (705) 555-1345	MacLaren Excavation 4564 Van Order Drive St. Joseph, ON (705) 555-6545
Distribution Parts	Water Products (Joe Turner) 3 Van Order Drive St. Joseph, ON (705) 555-6523	Waterworks Group (Ken Smith) 9 Main Street St. Joseph, ON (705) 555-8654
Disinfectant (Sodium Hypochlorite)	Bonneville Chemical 19 Andrew Street St. Joseph, ON (705) 555-8654	ClearTech 1-800-387-7503 orders@cleartech.ca
Underwater Services (Water Intake, Storage Tank Repair)	Marine Services (Shawn Penner) R.R.#1, St. Joseph, ON (705) 555-6843	Diving Services 1 Rink St. St. Joseph, ON (705) 555-6955 24 HOUR PAGER: 705-555-6864
Instrumentation Parts (Metering pumps, online analyzers etc.)	Metcon Sales & Engineering 15 Connie Cr., Unit 3 Concord, ON 905-738-2355 905-433-9627 (cell.)	SPD Sales Ltd. (Summa) 6467 Northam Dr., Mississauga, ON. 1-800-811-2811 905-678-2882
Instrumentation Calibration	Mike’s Calibration Services R.R.#2, St. Joseph, ON (705) 555-1234	Hetek Solutions Inc. Toronto, ON 416-621-1944

Quality of Supplier Products and Services

Assurance of the quality of essential supplies and services is achieved through documentation of applicable accreditation, licences and certifications. The supplier must sign a purchasing agreement, which specifies purchase requirements and confirms the conditions of delivery, including any required documentation. Specifically, SJU requires that suppliers of process chemicals verify the quality of each product through documented certification of chemical analysis. An enclosure accompanying the purchasing agreement provides an overview of the SJU QMS with specific reference to communications and supplier participation.

14 Review and Provision of Infrastructure and Resources

Annual Reports, prepared each February by the Operations Manager, include all elements required by current legislation. Commencing February 2007, the report also contains documentation of the condition of the treatment and distribution system infrastructure components based on performance and maintenance records from the previous year. The condition assessment includes comments on available capacity and recommendations for future upgrading or replacement.

The Annual Report is presented to the SJU Commission and forwarded to the owner.

The Infrastructure Review Procedure GEN-P8 is attached as Appendix H.

15 Infrastructure Maintenance, Rehabilitation and Renewal

Infrastructure maintenance, rehabilitation, and renewal are addressed by the following:

***Planned Maintenance*:** Planned maintenance is scheduled on an electronic spreadsheet stored on the central office computer server. Server files are backed up daily. Scheduled tasks are typically defined by manufacturer's literature when available and revised (or created) as needed according to operator experience / observations. Planned maintenance tasks are communicated to the person responsible by issuance of work orders from the Manager of Technical Services or the Manager of Operations through the Documentation / Process Technician. Completed work orders are reviewed and signed by the Manager of Technical Services or the Manager of Operations.

***Unplanned Maintenance*:** Unplanned maintenance tasks result from equipment malfunction or breakage.

Unplanned maintenance is authorized by the Manager of Technical Services, the Manager of Operations, the General Manager or the Overall Responsible Operator of the affected facility. The Overall Responsible Operator typically responds to unplanned maintenance during normal working hours while the on-call operator responds during off-hours. Documentation of unplanned maintenance tasks is recorded on work orders.

Measures to prepare for and expedite unplanned maintenance include equipment redundancy (back-up units), spare parts inventory, availability of updated plans / water atlas, as well as documented repair and safety procedures.

***Renewal / Capital Upgrades*:** Replacement of aging fixed heavy equipment, as well as upgrades, expansions, and in-ground systems improvements are planned by the General Manager, Manager of Technical Services, and Manager of Operations. All major expenses are identified in the budget and require approval by the SJU Commission.

Where practical, replacement of aging in-ground infrastructure is coordinated with road reconstruction activity conducted by the Town Works Department.

Infrastructure maintenance, rehabilitation, and renewal are described in greater detail in Procedure GEN-P3, attached as Appendix I.

16 Sampling and Monitoring

St. Joseph Utilities uses a sampling program for the St. Joseph Water Supply System, based on legislative requirements. This program is described in detail in the procedure entitled Sampling, Monitoring and Analysis SJ-WT/WD-P1, attached as Appendix J. Operators sample according to the AWWA Standards for Disinfecting Water Mains throughout any maintenance project undertaken within the St. Joseph water distribution system.

Specific sampling and monitoring procedures are established for operating the St. Joseph Water Supply System under abnormal circumstances. A detailed set of instructions for sampling and monitoring in response to adverse water quality is posted in the laboratory. These steps ensure that all legislative requirements are met at any time that the plant is producing water with parameters outside of compliance limits.

Laboratory results are acquired from in-house analyses, as well as from a selected accredited laboratory. In-house laboratory results are entered into an annual spreadsheet by a plant operator and then emailed to the Manager of Operations and the Documentation/Process Technician. Bacteriological and chemical results from the accredited laboratory are emailed to the Head Operator, the Manager of Operations, and the Documentation/Process Technician.

Copies of bacteriological and chemical analytical results are provided to members of the public in the Public Information binder located in the SJU office. In-house laboratory results may also be provided upon request. All analytical results are summarized in tables at the end of the calendar year and are discussed in the St. Joseph Water Supply System Annual Report. This annual report is provided to the owner and is also made available to any interested member of the public, upon request.

17 Measurement and Recording Equipment Calibration and Maintenance

Methods of measurement and recording equipment calibration and maintenance are described in detail in the procedure GEN-P5.

18 Emergency Management

The procedure entitled Emergency Conditions SJ-WT/WD-P2, attached as Appendix L, outlines the conditions at the St. Joseph Water Supply System that are considered to be major emergencies. This procedure also lists those persons responsible for initiating the response and recovery measures, as well as the process to be followed as emergencies escalate.

Specific instructions for responding to emergencies, including emergency situations that have the potential to result in acute drinking water health risks, are included in the plant and distribution system operations manuals. Each operator is required to review the written emergency procedures and contingency plans annually. When practical, emergency procedures are tested on an annual basis.

Emergency Contact List

General Manager	Susan Wentworth	705-555-4689 (home) / 705-555-8763 (cell)
Manager of Operations	Scott Smith	705-555-8742 (home) / 705-555-1256 (cell)
Manager of Technical Services	Joe Clark	705-555-1289 (home) 705-555-9832 (cell)

Overall Responsible Operators:

Treatment -	John Munro	705-555-7896 (home) / 705-555-8649 (cell)
Distribution -	James Morris	705-555-7894 (home) / 705-555-4568 (cell)

MOE Spills Action Centre	1-800-268-6060
MOE Office, St. Joseph	705-555-5689
Town of St. Joseph	705-555-8723
Emergency Management Co-ordinator	705-555-5489 (cell)

19 Internal Audits and Management Reviews

Internal Audits and Management Reviews are conducted at least once every twelve months to determine the effectiveness of the QMS, and to explore opportunities for improvement. Internal Audits and Management Reviews, in addition to Third-party Audits, are mechanisms used to fulfill the “check” and “improve” imperatives of the quality management system.

Detailed procedures for conducting internal audits (GEN-P6), and management reviews (GEN-P7) are attached as Appendices M and N respectively.

Appendix A
Document Control Procedure

Document Control

1.0 Procedure Description

This procedure outlines the methods used by St. Joseph Utilities (SJU) employees to control the creation, approval, distribution, and revision of all documents related to the Quality Management System (QMS).

2.0 Reason for Procedure

Consistent control ensures the currency, accuracy, and ease of retrieval of each QMS document. Proper maintenance of documents is critical for conformance with the Drinking Water Quality Management Standard (DWQMS), and also for compliance with drinking water legislation.

3.0 Responsibility

The designated QMS Representative, (or the alternate), shall be responsible for the control of all QMS documents. All documents must meet the approval of the QMS Representative before initial or revision issuance. The presence of a signature in the QMS header on the document indicates this approval.

4.0 Procedure

4.1 Documents requiring control by the QMS include:

- Internal Documents
  - Operational Plan
  - Procedures
  - Instructions
  - Forms (excluding work orders)
- External Documents
  - Applicable Drinking Water Regulations
  - Applicable Municipal Bylaws
  - Applicable Industry Standards
  - Equipment Manuals

The methods by which control over records will be exercised are described in the Record

Control Procedure (GEN-P2).

4.2 The QMS Representative shall maintain a current list of all internal and external documents. This list consists of the document title, QMS reference and date of last revision for each document.

4.3 Internal Documents

4.3.1 A standard header shall identify all QMS internal documents. This header contains the title of the document, QMS reference, indication of revision frequency, and signature of approval from the QMS Representative.

4.3.2 All original QMS internal documentation shall be stored at the SJU office on the central computer and in hard copy. The electronic version shall be password protected to restrict access to the QMS Representative and Alternate. The hard copy shall display the original signature of approval.

4.3.3 The currency of each internal document is ensured by comparison of the revision date in the document footer to that of the original stored at the SJU office.

4.3.4 A document change request form shall be used at any time changes to internal documents are required.

4.3.5 New or changed internal documents will be presented to all affected employees.

4.4 External Documents

4.4.1 Each external document affected by the QMS shall be clearly marked as "Controlled Copy" and initialed by the QMS Representative.

4.4.2 All controlled copies of external QMS documents shall be stored at the SJU office.

4.4.3 Current equipment manuals shall be indicated on the Equipment Information Form (GEN-F5) located in the equipment files at the SJU office.

4.5 Obsolete internal and external QMS documents are promptly removed from use.

4.6 Internal and external documents shall be reviewed at least annually, as a component of the annual internal audit and management review. A review may also take place when a significant change occurs in operations, such as a change in the type of process chemical or a change of equipment.

5.0 Associated Documents

- *Document Change Request (DCR)* *GEN-F1*
- *Record Control Procedure* *GEN-P2*
- *Equipment Information Form* *GEN-F5*

Appendix B
Records Control Procedure

PROCEDURE TITLE:	**Record Control**
QMS REFERENCE:	**GEN – P2**
TO BE REVISED:	**Annually or when QMS changes**
QMS REPRESENTATIVE:	

Record Control

1.0 Procedure Description

This procedure provides guidance for the identification, use, retention, storage and protection of all records generated that are related to the Quality Management System (QMS).

2.0 Reason for Procedure

Consistent control ensures the ease of retrieval of each record generated by St. Joseph Utilities (SJU) employees. Proper maintenance of records is critical for conformance with the Drinking Water Quality Management Standard (DWQMS) and also for compliance with drinking water legislation and regulations.

3.0 Responsibility

The designated QMS Representative, (or the alternate), shall be responsible for ensuring that an effective method for controlling all QMS records exists.

4.0 Procedure

4.1 Records may be retained electronically and/or in hard copy, but always according to the electronic file register.

4.2 Minimum retention times for all Ministry of the Environment required records shall be maintained as per the relevant regulations.

4.3 Filing and storage of paper records shall be such that they are protected from damage and are readily retrievable. Records from the current year and the previous year are kept in filing cabinets. All records older than two years are stored in bankers boxes, clearly marked with the dates and types of records contained within, either at the plant or at the SJU office.

4.4 Electronic records are stored on the SJU office central computer and are backed up each day.

4.5 All hardcopy and electronic records under the QMS are retained. No records are disposed of.

4.6 Records shall be made available to the public where required by legislation.

5.0 Associated Documents

- *Ontario Regulation 169/03 amended to O. Reg. 248/06*
- *Ontario Regulation 170/03 amended to O. Reg. 247/06*
- *Ontario Regulation 128/04*

Appendix C
Hazard Analysis Procedure

Drinking Water Hazard Analysis and Critical Control Point Determination

1.0 Procedure Description

This procedure describes the method of hazard identification, risk assessment, and critical control point determination used by St. Joseph Utilities (SJU). The procedure consists of four main exercises: hazard identification, risk assessment, critical control point determination, and critical limit identification. Each exercise is described in detail below.

2.0 Reason for Procedure

The systematic approach used for risk identification and assessment lessens the likelihood of overlooking potential treatment process hazards and associated risks to drinking water quality and public health. Hazard analysis, identifying critical control points, establishing critical limits and control instructions provides all operators with consistent direction for responding to conditions that pose a risk of jeopardizing drinking water quality.

3.0 Responsibility

The designated QMS Representative, with the assistance of the Overall-Responsible Operator, form a committee consisting of at least four persons who are familiar with the facilities. The Hazard Assessment Committee is responsible for identifying all actual and potential hazards, assessing the associated risks, determining critical control points, and setting critical limits. The committee communicates all associated procedures to the remainder of SJU operators through training sessions and documentation.

4.0 Procedure

The hazard analysis procedure is conducted at least annually, prior to the annual management review. These exercises may also be completed when a significant change occurs in operations, such as a change in the type of process chemical or a change of equipment.

4.1 Hazard Identification and Control Measures

Using a process flow diagram as a guide, the committee studies the water treatment process from the raw water intake to the point of customer use. While studying the diagram, the committee reviews the existing list of hazards and identifies any new potential hazards. Special attention is given to areas within the process where changes have occurred since conducting the previous hazard identification exercise. The form entitled *Hazard Identification* is used to record all hazards identified by the committee.

Once all of the hazards have been identified, the committee identifies measures in place to control the hazards and hazardous events that have been identified. Any measures that are currently in place to address the hazards are listed in the *Hazard Identification* form. The reliability and redundancy of equipment is considered during this exercise.

4.2 Risk Assessment

A risk assessment is performed for all events that are deemed to be controllable and the hazardous results of which are measurable. Controllable events are those that may be prevented through the actions of an operator. All other events are considered “emergency situations” and require the development of a contingency plan.

Each controllable event is assigned a numeric value ranging from 1 to 5 in three different

categories: likelihood, severity, and detectability (see Table 1). The three assigned numbers for each event are then multiplied to determine the overall risk value.

Table 1: Description of risk assessment criteria

Assigned Number	Likelihood	Severity	Detectability
1	Rare	Insignificant	Immediate
2	Unlikely	Minor	High
3	Possible	Moderate	Moderate
4	Likely	Major	Low
5	Almost Certain	Catastrophic	Undetectable

The highest overall risk values are typically indicators of critical events. Based on a review of the overall risk values and the associated events, a threshold number is chosen such that all events associated with risk values which are equivalent to or greater than the threshold number are considered critical. Discretion may be used when determining which events are indeed critical, regardless of the calculated risk. Careful evaluation is required for each hazard event.

In the case where an event having a higher calculated risk value is not determined by the committee to be critical, an explanation of the reasoning for this distinction is required. An explanation of the reasoning is also required when the committee deems an event with a lower calculated risk critical.

Note that there are three events that are always critically hazardous to water quality: high turbidity, inadequate primary disinfection, and low system pressure.

The risk assessment exercise is documented on the form entitled Risk Assessment (GEN-F4).

4.3 Critical Control Point Determination

From the identified critical events, the committee then traces backwards through the water

treatment process to determine the specific points where each critically hazardous event originates. These points then become control points. The final point in a series that leads to a critical event is identified as the critical control point.

Critical control points require the establishment of controlled conditions, including: critical control limits, equipment redundancy, and control and recovery procedures.

4.4 Critical Limits

Critical limits are established for values that measure critical events. The limits provide operators with a range of acceptable values within which no preventive or corrective actions are required. Critical limits define the point at which an operator must take action to prevent escalation of the critical event or to correct the critical event.
Critical limits are determined based on regulatory requirements, process monitoring capabilities, off-hours response time, and historical plant performance. Process alarms (if available) are normally set at, or near critical limits. Responses to breached critical limits are detailed in the Operations Manual.

5.0 Associated Documents

Refer to the following Operations Manual documents, which are also attached to this procedure:

- *Filtered Water Turbidity Critical Limit Response*
- *Primary Disinfection Critical Limit Response*
- *System Pressure Critical Limit Response*
- *Form: Hazard Identification GEN-F3*
- *Form: Risk Assessment GEN-F4*

Appendix D
Filter Effluent Turbidity Critical Limit Response

St. Joseph Water Supply System
INSTRUCTION TITLE: Filter Effluent Turbidity Critical Limit Response
QMS REFERENCE: SJ-WT/WD-I
TO BE REVISED: Annually or when QMS changes
QMS REPRESENTATIVE:

Critical Limit = 0.3 NTU

Critical Limit Response Instructions:

The following provides instruction to operators responding to a filtered water turbidity critical limit alarm. If any circumstances are encountered that are not addressed by the instructions below, the Overall-Responsible Operator and or the Manager of Operations must be immediately notified.

1. Check the treated water (not filtered) turbidity reading (and recent trending). A gradual increase in treated water turbidity indicates that the alarm condition is unlikely the result of a false reading and that the condition has been occurring for a significant period of time. If the elevated turbidity is observed in the finished water, proceed immediately to step 3. If not, the filtered water measurement triggering the alarm may be false, or has not yet begun to affect the treated water.

NOTE: If the filtered water turbidity is measured above 1 NTU for 15 consecutive minutes or longer, the operator must immediately follow the procedure for reporting adverse water quality in accordance with Ontario Regulation 170/03. Without compromising community fire protection or system pressure, every effort must be made to avoid pumping the adverse water to the distribution system. The Overall-Responsible Operator and / or the Manager of Operations must be promptly notified.

2. Collect and analyze samples of effluent from the abnormal filter(s) to confirm the continuous analyzer readings. If the reading(s) is confirmed proceed to step 3. If the reading cannot be confirmed, and is deemed erroneous, recalibrate the continuous analyzer to resolve the alarm condition.

3. If only one of the two filters is contributing the elevated turbidity, shut off that filter, directing process flow through the second filter. Visually examine the problem filter for any abnormalities. If the filter appears normal, proceed with backwashing when conditions are favorable. If, within 15 minutes following the backwash, turbidity levels have not returned to normal, shut off the problem filter and continue troubleshooting.
4. If both filters are contributing to the elevated turbidity, visually inspect the sedimentation tanks and filters for abnormalities. Check for changes in raw water turbidity and coagulant dosages. Adjust and / or resume coagulant flow as needed, based on jar testing results or comparable historical data.

Note that changes resulting from coagulant adjustment may not take full effect for up to 12 hours. (3 hydraulic retention times through flocculation tank, sedimentation tanks and filters)

5. If a treatment unit must be taken off line indefinitely and / or the cause of elevated turbidity cannot be determined and rectified by the above actions, the Overall-Responsible-Operator and the Manager of Operations must be immediately notified.
6. All observations and corrective actions directly and indirectly related to the alarm condition must be detailed in the plant log book in accordance with Ontario Regulation 128/04.

Rationale:

The critical limit of 0.3 NTU is a conservative value, significantly lower than the applicable regulatory and guideline limits. The limit is set at 0.3 NTU to allow adequate time for a corrective response before the regulatory limit is reached. Although much lower than the regulatory maximum, the control limit is approximately 10 times the normal historical average, clearly indicating an abnormal condition that requires further investigation and possible control

actions.

Considerations:

- Regulatory limit: 1 NTU
- Procedural limit: 95% of continuous measurement values = <0.5 NTU
- Monitoring capability: continuous with alarm
- Operator response time: 30 minutes
- Historical (normal) performance: <0.05 NTU
- Alarm limit: 0.3 NTU (approximately 10X normal historical average)
- Rate of filtration (2 filters on-line): 60 L/s = 0.060 m^3/s = 3.6 m^3/min (each filter)
- Rate of filtration (1 filter on-line): 120 L/s = 0.120 m^3/s = 7.2 m^3/min
- Filter volume: 2.590 m D x 5.791 m W x 8.534 m L = 125 m^3
- Filter hydraulic retention time (HRT): 125 m^3 / 3.6 m^3/min = 35 min
- Flocculation and sedimentation tanks combined volume: 1445 m^3
- Flocculation and sedimentation tanks HRT: 1445 m^3 / 7.2 m^3/min = 200 min

Safeguards:

The following safeguards are currently in place to prevent the distribution of filtered water that fails to meet the critical limit.

- Each filter turbidity analyzer is equipped with a high limit alarm (set to the critical limit) that rings at the plant when operators are present, and signals a dispatch to the on-call operator after normal working hours. The filtered water turbidity alarms will alert the operator to potential problems before the finished water being pumped to the distribution system is affected.

- Air binding of the filters is prevented by filter level alarms which sound if the level of water above the filter drops below normal operating range. This alarm would alert operators to loss of filter flow control or to disruptions in raw water flow.
- The rate of flow through the filters is limited by actuated valves which are controlled through the SCADA from a magnetic flow meter signal. Flow control avoids hydraulic overloading of the filters.
- Coagulant flow is monitored with a sensor which triggers an alarm if the flow is interrupted. Operators can respond to interruptions to coagulant flow before the problem becomes evident as elevated filtered water turbidity.
- Duty and standby coagulant pumps ensure the availability of a backup system in the event of duty pump failure
- The plant is constructed with two filters, each capable of treating the approved plant capacity. Filter redundancy allows the operator to temporarily remove a problematic filter from service without interrupting treated water production.
- Turbidimeters are recalibrated in accordance with manufacturer’s instructions and spare parts are immediately available.

Appendix E
Primary Disinfection Critical Limit Response

St. Joseph Water Supply System
INSTRUCTION TITLE: Primary Disinfection Critical Limit Response
QMS REFERENCE: SJ-WT/WD-I
TO BE REVISED: Annually or when QMS changes
QMS REPRESENTATIVE:

Critical Limit Values:

Clearwell Configuration	Minimum Clearwell Level (%)	Minimum Free Cl_2 Residual (mg/L)
Tanks 1 + 2 (series)	45	0.75
Tank 1 only (tank 2 O/S)	85	1.70
Tank 2 only (tank 1 O/S)	85	1.75

Critical Limit Response Instructions:

The following are instructions for operators responding to a disinfection system critical limit alarm. If any circumstances are encountered that are not addressed by the instructions below, the Overall-Responsible Operator and or the Manager of Operations must be immediately notified.

Low Chlorine Residual:

NOTE: If the calculated disinfection CT is inadequate using current conditions, the operator must immediately follow the procedure for reporting adverse water quality in accordance with Ontario Regulation 170/03. Without compromising community fire protection or system pressure, every effort must be made to avoid pumping the adverse water to the distribution system. The Overall-responsible Operator and / or the Manager of Operations must be promptly notified.

1. Confirm the low continuous analyzer reading by measuring the residual in a grab sample using the bench top colorimeter. If the continuous reading is not confirmed, proceed with

recalibrating or repairing the continuous analyzer in accordance with the manufacturer's instructions.

2. If the low continuous analyzer reading is confirmed, calculate the disinfection CT using current condition values (pH, temp., flow, clearwell level, free Cl_2 residual). If the CT is adequate, continue troubleshooting to determine the cause of the low residual.

3. If the calculated CT is inadequate, immediately correct the deficiency by one or all of the following: increase the disinfectant dosage rate, increase the level in the treated water clearwells, or decrease the instantaneous rate of flow by manually throttling the discharge valve on the active high lift pump(s). (Decreasing instantaneous flow is not a common practice as the pump capacity is needed to meet the peak water demand of the community. Although flows could be temporarily decreased to ensure adequate CT under emergency circumstances, there is a threat of eventually depleting the treated water storage.)

4. Confirm consistent disinfectant flow by checking the day tank level and calculating the dosage since the last time readings were taken. If dosage has decreased when compared to previous days, check the pump operation in manual mode using the calibration cylinder. Compare pump settings to those recorded during last few days noting any changes.

5. Check the disinfectant piping for leaks or potential obstructions on the suction and discharge sides of the pump. Clean / repair as needed.

6. If dosage has decreased, no leaks or blockages are found, and pump settings have not been changed, check the operation of the metering pump check valves and clean / repair as needed.

7. If the cause remains undetermined, check the concentration of the disinfectant using the procedure in the laboratory analysis section of the O & M Manual. If the concentration is

lower than normal, increase dosage appropriately, or replace the disinfectant with a fresh supply.

8. All observations and corrective actions directly and indirectly related to the alarm condition must be detailed in the plant log book in accordance with Ontario Regulation 128/04.

Low Clear well Level:

NOTE: If the calculated disinfection CT is inadequate using current conditions, the operator must immediately follow the procedure for reporting adverse water quality in accordance with Ontario Regulation 170/03. Without compromising community fire protection or system pressure, every effort must be made to avoid pumping the adverse water to the distribution system. The Overall-responsible Operator and / or the Manager of Operations must be promptly notified.

1. Calculate the disinfection CT using current condition values (pH, temp., flow, clearwell level, and free Cl_2 residual). If the CT is not adequate, if possible, discontinue high lift pumping until normal operating level can be restored.
2. If a normal level cannot be restored due to system demand, immediately increase the disinfectant dosage to achieve the required CT.
3. Monitor the plant closely until the treated water demand decreases allowing the clear well level to return to normal operating levels.
4. All observations and corrective actions directly and indirectly related to the alarm condition must be detailed in the plant log book in accordance with Ontario Regulation 128/04.

St. Joseph Water Supply System
INSTRUCTION TITLE: Primary Disinfection Critical Limit Response
QMS REFERENCE: SJ-WT/WD-I
TO BE REVISED: Annually or when QMS changes
QMS REPRESENTATIVE:

Rationale:

Five variables including instantaneous flow rate, clearwell volume, free chlorine residual, pH, and temperature are used to calculate disinfection CT. CT values are calculated every day using worst case variable values (values of the five variables that would result in the lowest achieved CT) for each of the above mentioned factors measured over the previous 24 hours.

The worst case values for each day were compiled for the previous year and independently sorted from best to worst condition. From the sorted lists of variables, values representing the 95^{th} percentile worst case for each variable were determined. (The 95^{th} percentile represents a variable value that is worse than 95 percent of the values observed during the previous year.) The control limits were determined as the value that yielded adequate disinfection CT when used with the 95^{th} percentile worst case values for the other four calculation variables.

Use of 95^{th} percentile values results in conservative limits that minimize risk to public health while avoiding overly stringent, impractical control limits that would undoubted result in nuisance false alarms if derived from absolute worst case values.

Considerations:

- 2 clear well configuration normally run in series operation, single tank capability
- Regulatory Limits: 2-log (99%) removal / inactivation of *Cryptosporidium* oocysts

  3-log (99.9%) removal / inactivation of *Giardia* cycsts of which **0.5-log must be provided through disinfection**

  4-log (99.99%) removal / inactivation of viruses of which **2-log must be provided through disinfection**
- Disinfecting agent(s): conventional filtration, sodium hypochlorite (free chlorine)
- Monitoring capability: continuous free chlorine residual and clearwell level with alarms
- Operator response time: 30 minutes
- Normal free chlorine residual: 0.8 mg/L – 1.8 mg/L (depending on other CT factors)

- Alarm limit (minimum): 0.7 mg/L
- Conventional filtration disinfection credits: 2-log removal *Cryptosporidium*
  2.5-log removal *Giardia*
  2-log removal of viruses
- Clearwell T_{10}/T (baffle factor): 0.7
- Clearwell volume: 980 m^3
- 95^{th} percentile "worst case" CT factors (2005):
  Minimum temp.: 1.3 C
  Minimum clearwell level: 51.7%
  Maximum pH: 7.02

Maximum instantaneous flow: 10,450 m^3/d

Safeguards:

The following safeguards are currently in place to prevent improperly disinfected drinking water from passing into the distribution grid.

- Treated water free chlorine residual is measured continuously with all discreet data values saved in digital files. The chlorine residual analyzer is equipped with alarm set points (set to critical limit) which will notify an operator of abnormal residuals.
- In the event of a low chlorine residual alarm condition, an interlock switch prevents the operation of the high lift pumps.
- Clear well levels are continuously monitored with all measured levels recorded in digital files. If the level drops to the critical limit, an alarm will sound to alert operators.
- Disinfectant flow is monitored with a sensor which triggers an alarm if the flow is interrupted. Operators can respond to interruptions to disinfectant flow before the problem becomes evident in the finished water.

- Duty and standby disinfectant pumps ensure the availability of a backup system in the event of duty pump failure.
- Treated water free chlorine residuals are measured in treated water grab samples typically twice each day using bench top instrumentation. The accuracy of the continuous analyzer is checked by comparison to testing conducted using the bench top colorimeter.
- Replacement parts are available at the plant in the event of a continuous analyzer malfunction.
- Treated water samples collected at the plant and throughout the distribution system are tested each week for bacteriological contamination to confirm the effectiveness of the disinfection process.

Appendix F
Distribution System Pressure Critical Limit Response

St. Joseph Water Supply System
INSTRUCTION TITLE: Distribution System Pressure Critical Limit Response
QMS REFERENCE: SJ-WT/WD-I
TO BE REVISED: Annually or when QMS changes
QMS REPRESENTATIVE:

Critical Limit Values:

Elevated Storage Tank Minimum Level = 3.7 m

High Lift Pump Discharge Header Minimum Pressure = 40 psi.

Booster Station Alarm (any)

WTP Power Interruption

Critical Limit Response Instructions:

The following are instructions for operators responding to a distribution system pressure critical limit alarm. If any circumstances are encountered that are not addressed by the instructions below, the Overall-Responsible Operator and or the Manager of Operations must be immediately notified.

Elevated Storage Tank Low Level

1. Check the operation of the high lift pumps, by noting distribution system flow. If necessary, start a pump.
2. If high lift pumping is okay, check the tower monitoring chart recorder for signs of increased system demand or a water main break. (indicated by long slow filling cycle, or drop during filling cycle)
3. Attempt to determine if high volume water users have increased consumption. (i.e. Is there a fire? Is industry consumption up?) If the increased demand is for emergency use (i.e. a fire), turn on a second high lift pump to attempt to keep up with demand until the emergency concludes.
4. If no significant increase in water use is evident, attempt to determine if there is a water main break. Call the office and fire hall to ask if any calls have been received from the public reporting lower than normal water pressure or emergence of surfacing water.

When the location of the break is determined, isolate the area of the break and proceed with repair.

High Lift Pump Low Discharge Pressure

1. Check the tower level on the SCADA and on the chart recorder to confirm normal operating level. If the level is low, proceed with instructions for responding to a low tower level.
2. Check the operation of the high lift pumps by noting the distribution system flow. If needed, start a high lift pump.
3. If the tower level and high lift pump operation is normal, it is likely that the pressure gauge is malfunctioning. Repair or replace the gauge as needed.

Booster Station Alarm

1. In the event of a general power failure, contact Hydro One to report the problem and to determine when power will resume. Notify critical customers in the pressure zone that normal pressure cannot be resumed until power is restored by Hydro One.
2. If low suction pressure is preventing booster pump operation, check the elevated storage tank level and high lift pump operation.
3. If the elevated storage tank and high lift pumps are normal, check the system pressure upstream from the station at the nearest hydrant. If the hydrant pressure is normal, check the suction pressure gauge and repair or replace as needed.
4. If the pump is not operating, check the variable frequency drive and reset if necessary.
5. If the duty pump will not start due to a mechanical or electrical malfunction, switch duty to the standby pump and resume operation.
6. If neither pump will start due to a suspected electrical problem, immediately notify a staff maintenance electrician, or a local contract electrician.

Power Interruption at WTP

1. The WTP is equipped with a backup diesel powered generator, capable of running all instrumentation, metering pumps, and one high lift pump. The generator will start automatically following a short delay when power is interrupted. An operator must remain at the plant while the auxiliary diesel generator is running. The operator must monitor all necessary treatment equipment and make arrangements for refilling the fuel tank if needed. The operator must also contact Hydro One to determine the anticipated duration of the interruption so that alternate staffing can be scheduled as needed. If the diesel generator fails to start, immediately notify a staff maintenance electrician or the contractor responsible for generator maintenance.

Rationale:

Positive pressure must be continuously maintained throughout the distribution system to prevent potential incidents of backflow. Backflow occurs when potentially contaminated liquid reverses flow through a private connection and enters the municipal system creating a potentially high health risk to other users.

In the central zone, pressure is controlled under normal circumstances by the level in the elevated storage tank. Given that the static pressure measured at the area of highest system head loss (eastern extreme of Rogers Road) is 45 psi, and the normal operating level in the storage tank is approximately 35 m, the level in the storage tank could drop 17.5 m while theoretically maintaining a static pressure of 20 psi at Rogers Road.

A decrease of 17.5 m would result in a level below the bottom of the elevated tank (in the riser pipe). Given that the level in the relatively small diameter riser pipe will drop extremely quickly under normal demand conditions, the critical tank level limit must be set above the top of the riser pipe to allow sufficient operator response time to prevent a low pressure condition on Rogers Road.

Elevated Tank Critical Level

Assuming no high lift pumping capability and a system demand equivalent to the treatment plant capacity (10,450 m^3/d), the elevated tank would be emptied in approximately 2 hours and 35 minutes. Ideally, the critical level must be set to allow a 30 minute response time, plus an additional 30 minutes to assess and begin to rectify the situation before the level drops to the top of the riser pipe. Therefore, based on a desired response allowance of 60 minutes, the critical level is 1hr/2hr 35min * 100% or approximately 40 percent of the full tank level. Forty percent of the elevated tank depth equates to approximately 3.7 m. The low level alarm must be set at or above 3.7 m.

High Lift Pump Discharge Pressure Critical Limit

The pressure signal from the high lift pump discharge header serves as a back up alarm in the event of the failure of the elevated storage tank low level alarm. Based on engineering drawings, the depth of the storage tank is approximately 9.1 m. Given that the static pressure observed at the high lift pumping station is 70 psi when the tower level is 9.1 m, a drop to 3.7 m would yield a static pressure of approximately 62 psi. Therefore, the critical limit for high lift pump discharge pressure is set to approximately 60 psi.

Booster Station Critical Limits

The booster stations provide additional system pressure to areas on the distribution system that experience significant pressure loss due to increased system head loss associated with geographical distance from the high lift pumps and elevated storage tank, and elevation differences in the local geography. Under ideal circumstances, it is desirable to maintain system pressure at or above 45 psi in all service areas.

It is important to note that system pressure in both areas serviced by booster stations will remain positive even if the booster pumps fail to function, provided the system pressure measured at the WTP remains at, or above 60 psi. At 60 psi, the static pressure at the highest point on the Collins zone is less than 10 psi if the booster pumps are off. Similarly, in the Fairground zone, the

system pressure, although positive, does not meet the users needs if the booster pumps are off. It is therefore important that immediate actions are taken to correct booster station alarm conditions. The booster station critical limits are defined by the alarm set points.

Considerations:

- Pressure zones: 3 including:
    i. main central area of town fed by WTP high lift pumps and 1135 m^3, 38.1 m high elevated storage
    ii. northerly commercial area fed by the Fairground Booster Station, and
    iii. elevated southerly residential area fed by the Collins Street Booster Station
- Pressure controls:
    i. Fairground and Collins Booster Stations equipped with duty and standby pumps controlled by variable frequency drives which maintain continuous discharge pressures of 80 psi and 85 psi respectively.
    ii. Elevated storage tank, providing approximately 35 m head pressure at normal operating level (~70 psi static pressure measured at the WTP)
    iii. High lift pump variable frequency drive maintaining set point pressure (approximately 70 psi) if elevated storage tank must be isolated.
- Operator response time: 30 minutes
- Monitoring:
    i. continuous pressure monitoring at booster stations equipped with low suction and discharge pressure alarms
    ii. continuous tower level monitoring with high and low level alarms
    iii. high lift pump discharge pressure monitoring with SCADA alarm points

- Location of lowest pressure in central zone: eastern extreme of Rogers Road main where the static pressure is approximately 45 psi when operating at normal elevated storage tank level

Safeguards:

The following safeguards are currently in place to prevent loss of positive distribution system pressure:

- One 1,135 m^3, 38 m tall elevated storage tank.
- Continuous elevated storage tank level monitoring complete with low and high level alarms.
- Lead, lag, and standby high lift pumps, each capable of meeting peak demands.
- Continuous pressure measurement at the high lift pump discharge header complete with low pressure alarm capability
- Continuous pressure monitoring at the Fairground and Collins booster stations with low pressure alarms
- Pumping redundancy at Fairground and Collins booster stations.
- Power failure alarms at Fairground and Collins booster stations.

Reporting and Recording

1. All observations and corrective actions directly and indirectly related to responses to low pressure conditions must be detailed in the plant log book.
2. If a low pressure event in the distribution system is encountered where it is suspected that backflow or other contamination of the distribution system may have occurred, the Overall-Responsible Operator and or the Manager of Operations must be immediately

notified. Although not required by regulation, notifications will also be made to the local Medical Officer of Health and the Ontario Ministry of the Environment.

Appendix G
Secondary Disinfection Critical Limit Response

St. Joseph Water Supply System
INSTRUCTION TITLE: Secondary Disinfection Critical Limit Response
QMS REFERENCE: SJ-WT/WD-I
TO BE REVISED: Annually or when QMS changes
QMS REPRESENTATIVE:

Critical Limit = 0.5 mg/L free Cl_2

Critical Limit Response Instructions:

The following provides instruction to operators responding to a distribution system low chlorine residual (secondary disinfection) critical limit alarm. If any circumstances are encountered that are not addressed by the instructions below, the Overall-Responsible Operator and or the Manager of Operations must be immediately notified.

1. Using the portable chlorine residual analyzer kit, repeat the measurement of free residual in a grab sample collected at the site of the critical limit alarm. If the reading confirms the alarm condition, proceed to step 2. If the reading does not confirm the alarm condition, service / calibrate the analyzer in accordance with the manufacturer or St. Joseph Utilities procedure.

NOTE: If the distribution free chlorine residual measured by an on-line monitor is continuously below 0.05mg/L for 15 consecutive minutes or longer, OR if a grab sample from the distribution system has a free chlorine residual below 0.05 mg/L, the operator must immediately follow the procedures for reporting adverse water quality (Schedule 16) and for corrective actions (Schedule 17) in accordance with Ontario Regulation 170/03 as amended. The Overall-Responsible Operator and / or the Manager of Operations must be promptly notified.

2. Ensure that the residual of treated water leaving the plant is consistent with recent operating values. If not, determine the cause and make the appropriate repair / correction. (See Primary Disinfection Critical Limit Response)

3. Open the nearest downstream hydrant from alarm condition location and continue flushing until the measured chlorine residual is restored above the alarm condition limit.

4. If the cause of low distribution system chlorine residual cannot be determined and rectified by the above actions, the Overall-Responsible-Operator and the Manager of Operations must be immediately notified.

5. All observations and corrective actions directly and indirectly related to the alarm condition must be detailed in the plant log book in accordance with Ontario Regulation 128/04.

Rationale:

The critical limit of 0.5 mg/L free chlorine residual is a conservative value, significantly higher than the applicable regulatory and guideline limits. The limit is set at 0.5 mg/L free chlorine residual to allow adequate time for a corrective response before the regulatory limit is reached. Although much higher than the regulatory minimum, the control limit is approximately half the normal historical average, and is indicative of an abnormal condition that requires further investigation and possible control actions.

Considerations:

- Regulatory limit: 0.05 mg/L as free chlorine residual
- Guideline limit: 0.2 mg/L as free chlorine residual
- Monitoring capability: continuous with alarm at one location, weekly grab samples from dedicated sample collection hydrants (located at distant extremes from the WTP)
- Operator response time: 30 minutes
- Historical (normal) performance: >0.2 mg/L free chlorine residual
- Alarm limit: 0.5 NTU

Safeguards:

The following safeguards are currently in place to prevent the failure of the secondary disinfection process.

- Primary disinfection is continuously monitored and controlled to ensure that treated water leaving the WTP enters the distribution system containing a free chlorine residual above the critical control limit for primary disinfection, and well above the secondary disinfection regulatory minimum.
- The distribution system continuous free chlorine analyzer is equipped with a low limit alarm (set to the critical limit) that rings at the plant when operators are present, and signals a dispatch to the on-call operator after normal working hours. The distribution system chlorine alarm will alert the operator to potential problems before the residual drops to the regulatory minimum.
- Chlorine residuals are measured in grab samples collected weekly from dedicated sample hydrants located at the distant extremes of the distribution system. Residuals measured at those "worst case" locations are trended and adjustments are made at the WTP as necessary.
- Annual flushing of distribution system hydrants removes debris that limits the effectiveness of secondary disinfection and lowers free residuals.
- Duty and standby hypochlorite pumps with automatic switching ensure the availability of a backup system in the event of duty pump failure. Flow sensors activate an alarm if disinfectant delivery is interrupted.
- Chlorine analyzers are routinely calibrated in accordance with manufacturer's instructions and spare parts are immediately available.

Appendix H
Infrastructure Review

St. Joseph Water Supply System General QMS Administration
PROCEDURE TITLE: Infrastructure Review
QMS REFERENCE: GEN-P8
TO BE REVISED: Annually or when QMS changes
QMS REPRESENTATIVE:

Infrastructure Review

1.0 Procedure Description

This procedure defines the process used by St. Joseph Utilities (SJU) to review the adequacy of the infrastructure and resources necessary to operate and maintain the drinking water system safely and effectively.

2.0 Reason for Procedure

The Infrastructure Review Procedure ensures periodic evaluation of the condition and capacity of infrastructure components. The results of the evaluation are used to prioritize future resource allocation.

3.0 Responsibility

The Manager of Operations, in consultation with the General Manager, and Manager of Technical Services shall prepare the Infrastructure Review Report.

4.0 Procedure

4.1 This procedure is applicable to all SJU infrastructure components that fall under the scope of the QMS.

4.2 Infrastructure review is conducted at least once each year.

4.3 The above named managers shall consider previous Infrastructure Review Reports, input from union staff, MOE Compliance Inspection Reports, flow data trends, water quality reports, and maintenance records to determine priority needs.

4.4 The Infrastructure Review Report shall be included as a section in the Annual Report and presented at a Commission Meeting. The Annual Report shall be forwarded to the owner and made available to any member of the public in accordance with legislation.

4.5 The Infrastructure Review Report shall be revisited and revised (if deemed necessary) by management during the preparation of the proposed annual budget.

5.0 Associated Documents

- *MOE Compliance Inspection Reports*
- *Plant daily rounds records (spreadsheet summary)*
- *Plant laboratory records (spreadsheet summary)*
- *Drinking Water Quality Management Standard*

Appendix I
Maintenance Procedure

Maintenance, Rehabilitation and Renewal

1.0 Procedure Description

This procedure describes the maintenance activities performed within the drinking water systems operated by St. Joseph Utilities, including preventative maintenance, unscheduled maintenance, and system rehabilitation and renewal.

2.0 Reason for Procedure

Maintenance activities may significantly impact the quality of drinking water produced and/or delivered to the customers. Pre-planning and a documented systematic approach to addressing maintenance activities, where possible, can minimize this impact.

3.0 Responsibility

The following are responsible for maintenance and renewal activities depending on the urgency of the task, risk to public health, and financial requirements:

- St. Joseph Utilities Commission
- General Manager
- Managers of Technical Services and Operations
- Overall Responsible Operators for treatment and distribution systems

4.0 Procedure

4.1 All maintenance activities shall be associated with a specific work order number.

4.1.1 Regular work orders are three-page documents, each with a white, pink and yellow copy.

4.1.2 The pink copy is retained at the office, while the white and yellow copies are issued to the person responsible for ensuring the completion of the

work. Upon completion, the person who performed the work (or immediate supervisor) signs the white and yellow copies.

4.1.3 If the work was associated with a customer, both the white and yellow copies are reviewed and signed by the Manager of Technical Services or the Manager of Operations. The yellow copy is placed in the customer file, and the white copy in the technical services files.

4.1.4 If the work was performed at the water treatment plant, the yellow copy is filed on site and the white copy is reviewed and signed by the Manager of Technical Services or Manager of Operations, then placed in the technical services files.

4.1.5 Pink copies shall be discarded once the other copies have been filed.

4.2 Work orders for regular preventative maintenance shall be issued according to a schedule. These scheduled work orders consist of a single yellow page.

4.2.1 The Manager of Technical Services and the Manager of Operations through the Documentation/Process Technician issue preventative maintenance work orders. Preventive maintenance tasks are typically defined by manufacturer's literature when available and revised (or created) as needed according to operator experience / observations. These tasks include, but are not limited to, oil changes, mechanical inspections, and filter and belt replacements.

4.3 Routine system rehabilitation and renewal shall be addressed annually during budget preparation, typically one to two months prior to the calendar year end for the budget applying to the following year. A list of required replacement or desired new equipment is compiled and prioritized by the St. Joseph Utilities management team, typically including the General Manager, Manager of Technical Services and Manager of Operations. A proposed budget is presented

by the General Manager to the Commission with justification provided for the requested maintenance and capital projects. If the Commission does not approve the proposed budget, the management team prepares a revised, reduced version by deferring lower priority items.

4.4 Major upgrades and expansion are addressed as needed based on regulatory requirements, assessment of risk to public health, development review, reserve account balances, and grant or loan availability.

4.5 If feasible, rehabilitation or replacement of water distribution piping is coordinated with the Town Works Department to coincide with scheduled road resurfacing projects.

Appendix J
Drinking Water Sampling, Monitoring and Analysis

Sampling, Monitoring and Analysis

1 Procedure Description

This procedure describes the sampling schedule and analytical program used for monitoring water quality at the St. Joseph Water Supply System. It also outlines the responsibilities of operators and outside agencies in regards to analyses performed and reporting duties.

2 Reason for Procedure

Regular and strict adherence to a schedule is required to meet legislated and regulatory requirements and to ensure that all operators involved are aware of their responsibilities and the required timing. All sampling and analysis is performed to comply with Ontario Regulation 170/03, as amended, or to monitor additional parameters that affect water quality monitoring or aid in process control.

3 Responsibility

Only those operators who have been issued a valid Drinking-Water Operator Certificate are permitted to carry out drinking water sampling and conduct laboratory analyses.

The operator on duty performs all drinking water sampling, as well as the daily analyses. All other analyses must be performed by the staff of an accredited laboratory.

4 Procedure

4.1 Continuous Monitoring

4.1.1 Filter effluent turbidity, treated water turbidity, treated water free chlorine residual and raw water total chlorine residual are monitored continuously with online analyzers and displays located in the plant laboratory.

4.1.2 The operator on duty shall verify online monitoring readings daily by comparison to bench-top results (see section 4.2 Daily Sampling and Analysis). The bench-top results and analyzer readings are recorded on the weekly laboratory sheet (SJ-WT/WD-F5).

4.1.3 Chlorine analyzers shall be adjusted when necessary per manufacturer's instructions (see instructions: Online Chlorine Analyzer Calibration).

4.1.4 Turbidity analyzers shall be calibrated at least quarterly (see instructions: Online Turbidity Analyzer Calibration).

4.1.5 A SCADA system, which provides operators with the capability to continuously monitor all measurable plant parameters, is currently in development.

4.2 Daily Sampling and Analysis

4.2.1 Routine laboratory tests shall be conducted daily at the plant by the operators on duty to confirm online analyzer readings, as well as to check additional parameters that aid in water quality monitoring and process control.

4.2.2 Data shall be recorded on weekly laboratory log sheets (SJ-WT/WD-F5), and filed in the plant filing cabinet by year. Select data is transferred to a summary

EXCEL spreadsheet and forwarded to the Manager of Operations, at least monthly.

4.2.3 Samples are collected at three points in the treatment process; raw water, process water and treated water. Raw water and treated water are sampled from taps located in the laboratory, while process water is obtained as a grab sample from the top of the filters.

4.2.4 Daily water samples shall be tested for the parameters listed in Table 1. Typically, chlorine residuals, turbidity and pH are performed twice daily, once in the morning, and again in the afternoon.

Table 1: Required daily analysis for raw water, process water and filtered water from the St. Joseph Water Supply System

Raw Water	Process Water	Treated Water
Free Chlorine Residual	Turbidity	Free Chlorine Residual
Total Chlorine Residual	Temperature	Total Chlorine Residual
Turbidity		Turbidity
Temperature		Temperature
pH	pH	pH
Colour	Colour	Colour
Alkalinity		Alkalinity
		Aluminum

See Instructions for analysis of all parameters listed in Table 1.

4.2.5 A distribution sample shall be tested daily for free and total chlorine residual. These analyses are performed at the St. Joseph Wastewater Plant, where the sample is collected from the cold-water tap in the laboratory (see instructions for Measuring Chlorine Residuals).

4.3 Weekly Sampling and Analysis

4.3.1 Weekly bacteriological analysis is performed on raw water and treated water from various points in the distribution system. Each sample is tested for *Escherichia* coli (or fecal coliforms), total coliforms, and the general bacteria population expressed as background colony counts or heterotrophic plate count (HPC). A maximum of 25% of the distribution samples may be tested for presence/absence only.

4.3.2 Weekly samples collected for bacteriological testing shall include non-chlorinated raw water, chlorinated raw water, treated water, and distribution samples (see instructions: Bacteriological Sampling).

4.3.3 Non-chlorinated raw water shall be collected from the low lift pump discharge header at the Lake St. Joseph Raw Water Pumping Station (see instructions: Sampling Non-Chlorinated Raw Water).

4.3.4 Chlorinated raw water and treated water shall be collected from the taps in the laboratory (see instructions: Sampling Drinking Water from Taps).

4.3.5 Distribution samples shall be collected from green designated sample hydrants located at several points throughout the system (see Figure: Location of Distribution Sample Hydrants; Instructions: Sampling Drinking Water from Designated Sample Hydrants).

4.3.6 Bacteriological samples shall be delivered in designated coolers to the accredited laboratory on the same day that they are collected.

4.3.7 A Chain of Custody form, including the sample details and free chlorine residual of the samples, shall be completed and submitted to the laboratory with the samples. The pink copy of this form is immediately returned to the operator for filing at the plant.

Also refer to section 4.8.2 - Additional Sampling Requirements (Thickener Performance)

4.4 Monthly Sampling and Analysis

Refer to section 4.8.1 - Additional Sampling Requirements (MIB/Geosmin).

4.5 Quarterly Sampling and Analysis

Every three months (usually in January, April, July and October), drinking water from the distribution system shall be tested for Trihalomethanes (THM's). THM samples must be collected nearest to the furthest point in the distribution system as possible, the green designated sample hydrant at 380 Industrial Road (see instructions: THM Samples). Nitrates/Nitrites samples are collected from the treated water tap in the plant laboratory (see instructions: Nitrate/Nitrate Samples).

4.6 Annual Sampling and Analysis

Samples are collected every 12 months (typically collected in January) and must be analyzed for inorganics (lead and Schedule 23) and organics (Schedule 24). Samples to be analyzed under Schedule 23 and Schedule 24 shall be collected from the treated water tap located in the plant laboratory. The sample to be analyzed for lead shall be collected from a point in the distribution system where the presence of lead may be suspected.

4.7 Sampling and Analysis Required Every Five Years

Treated water collected from the treated water tap in the plant laboratory must be

analyzed for sodium and fluoride every 60 months.

4.8 Additional Sampling Requirements

4.8.1 MIB/Geosmin

Analysis of the influent and effluent from each of the two filters shall be performed monthly to ensure that the granular activated carbon (GAC) layer of the filter media is functioning to control taste and odours. MIB (2-methylisoborneol) and Geosmin are the compounds measured in the samples, as they are commonly associated with taste and odour problems in a water supply (see instructions: Sampling for MIB/Geosmin).

4.8.2 Thickener Performance

Composite samples of thickener effluent shall be collected three times per week from the automatic sampler located on the top of the treatment unit, and analyzed for suspended solids. Thickened sludge from the bottom of the treatment unit shall be sampled once per week from a sample tap located on the side of the settling tank, and analyzed for suspended solids.

4.9 Calibration Requirements

All instruments in use at St. Joseph Utility facilities shall be calibrated once every three months to remain consistent with other instrumentation.

Refer to all instructions for calibration.

4.10 Adverse Results

If the accredited laboratory discovers adverse water quality in a sample, they are obligated to notify someone at St. Joseph Utilities within 24 hours. Other adverse water results prescribed by Schedule 16 of O. Reg. 170/03 must be immediately reported by SJU to the Medical Officer of Health and the Ministry of the Environment.

5 Associated Documents

Procedures: *Regulatory Reporting*
Response to Indication of Adverse Water Quality
Instructions: *Alkalinity*
Aluminum
Apparent Colour
Bacteriological Sampling

Appendix K
Measurement and Recording Equipment Calibration and Maintenance

Measurement and Recording Equipment Calibration and Maintenance

1.0 Procedure Description

This procedure describes the method used by St. Joseph Utilities (SJU) to ensure that all measurement and recording equipment is calibrated and maintained.

2.0 Reason for Procedure

Accuracy of measurement and recording equipment is essential to providing quality drinking water to the consumer with confidence that the characteristics of the water meet or exceed the legislated requirements and internal targets set by SJU.

3.0 Responsibility

The Operator/Maintainer, under the direction of the Manager of Operations, shall conduct calibration and maintenance of all continuous monitoring and recording equipment. The Overall Responsible Operator shall ensure that all calibration and maintenance for bench-top equipment is performed at the required frequency.

4.0 Procedure

4.1 This procedure is applicable to the following types of equipment in use at facilities operated by SJU:

- continuous chlorine residual analyzers
- continuous turbidimeters
- portable colorimeters
- portable turbidimeters

4.2 The Manager of Operations, through the Documentation/Process Technician, issues a single-page scheduled work order to the Operator/Maintainer to indicate when calibration of continuous monitoring equipment is required.

4.3 The frequency of calibration shall be at least that which is required by O. Reg. 170/03, or suggested by the manufacturer, whichever is more often.

4.4 All calibration and maintenance shall be performed according to the manufacturer's instructions.

4.5 All calibrations shall be recorded in the designated calibration binder at the water treatment plant.

5.0 Associated Documents

The following instruction documents:

- *Calibrating the Hach 1720D Turbidimeter*
- *Calibrating the Hach 1720C Turbidimeter*
- *Calibrating the Hach 2100P Portable Turbidimeter*
- *Calibrating the Hach DR-890 Portable Colorimeter*
- *Calibrating the Online Chlorine Analyzers*

Appendix L
Emergency Conditions Procedure

St. Joseph Water Supply System	
PROCEDURE TITLE:	Emergency Conditions
QMS REFERENCE:	SJ-WT/WD-P2
TO BE REVISED:	Annually or when QMS changes
QMS REPRESENTATIVE:	

Emergency Conditions

1.0 Procedure Description

This procedure describes conditions at the St. Joseph Water Supply System that are considered to be emergencies, as well as those persons responsible for initiating the response and recovery measures.

2.0 Reason for Procedure

Establishing a procedure for emergency conditions indicates a level of preparedness, promotes an efficient response, and supports a rapid recovery.

3.0 Responsibility

The certified operator on duty must be capable of identifying and be prepared for responding to any emergency condition that may arise at the water treatment plant or within the distribution system. Operator training is conducted regularly to ensure the safe and timely response to emergencies.

4.0 Procedure

4.1 Major Emergencies

- Adverse Water Quality
- Major Power Failure
- River Raw Water Source Required

4.2 Response

4.2.1 In the event of an identified emergency, the Overall Responsible Operator and the Manager of Operations, Manager of Technical Services or General Manager shall be contacted immediately. The General Manager is designated as the lead representative of SJU and will be responsible for overall management, decision making, and

communications. In the event that the General Manager is unavailable, the Manager of Operations or the Manager of Technical Services, in this order, shall assume this role / responsibility.

4.2.2 The Mayor and CAO of the Town of St. Joseph shall only be notified in the event that water cannot be supplied to the town in sufficient amounts for fire protection, or that water quality poses an acute health risk to customers and a boil water advisory or drinking water advisory must be issued. The Mayor and CAO will be primary contacts for all required communications with the owner.

5.0 Associated Documents

Refer to the following O & M Manual documents:

- *Response to Adverse Water Quality*
- *Power Failure*
- *River Water*
- *Issuing A Boil Water Advisory*

Appendix M
Internal Audit Procedure

Internal Audit

1.0 Procedure Description

This procedure defines the process used by St. Joseph Utilities (SJU) to conduct internal audits of the Quality Management System (QMS) for the St. Joseph Water Supply System.

2.0 Reason for Procedure

Internal audits are conducted to confirm that the QMS is effectively implemented and meets or exceeds the requirements of the Ministry of the Environment's Drinking Water Quality Management Standard (DWQMS).

3.0 Responsibility

Internal audits shall only be conducted by persons approved by the QMS Representative and having the following qualifications:

- St. Joseph Utilities employees who have completed internal audit training.
- Employees of other operating authorities who have completed internal audit training and who have completed a minimum of two internal audits of quality management systems within their own organizations.

4.0 Procedure

4.1 This procedure is applicable to St. Joseph Utilities management, water treatment plant operations, and distribution activities that fall under the scope of the QMS.

4.2 Internal audits are conducted at least once every twelve months.

4.3 Internal auditors will be selected by the QMS Representative.

4.4 Internal auditors shall review the DWQMS and previous internal and third-party audit reports in preparation for the audit.

4.5 The audit checklist created and maintained by the QMS Representative shall be used by the internal auditor as a guideline and for record-keeping purposes for conducting the interviews and document review during the audit.

4.6 The audit report shall be in the form of a completed audit checklist.

4.7 Where a non-conformance to the DWQMS is found during the internal audit, this shall be communicated within the audit report by attaching the Corrective Action Request (CAR) form *(GEN-F7)*. It is the responsibility of the QMS Representative to ensure that all CARs are followed up and responses to the CARs are provided to the internal auditor within 45 days of the internal audit.

4.8 When all CARs have been responded to, the internal audit report and response to CARs are submitted to the Management Review Committee. The internal audit shall be considered closed when this is complete.

5.0 Associated Documents

- *Management Review Procedure (GEN-P7)*
- *Internal Audit Checklist*
- *CAR Form (GEN-F7)*
- *Internal Audit Schedule*
- *Drinking Water Quality Management Standard*

Appendix N
Management Review Procedure

Management Review

1.0 Procedure Description

This procedure defines the process for the review of the effectiveness of the Quality Management System (QMS) by the Management Review Committee.

2.0 Reason for Procedure

Management reviews are conducted to assess and ensure the continuing suitability, adequacy, and effectiveness of the QMS.

3.0 Responsibility

Management reviews shall be conducted during a meeting of the following participants:

- The Chairperson of the St. Joseph Utilities Commission.
- The General Manager of St. Joseph Utilities.
- The QMS Representative and Alternate
- The Manager of Operations
- The Manager of Technical Services

Other participants may be added at the discretion of the Management Review Committee. The meeting is chaired by QMS Representative or Alternate.

4.0 Procedure

4.1 This procedure is applicable to St. Joseph Utilities management, water treatment plant operations, and distribution and collection activities that fall under the scope of the QMS.

4.2 A management review shall be conducted at least once every twelve months, following the completion and documentation of an internal audit and prior to the next scheduled third-party audit.

4.3 Prior to the Management Review Meeting, the QMS Representative or Alternate shall provide a meeting agenda and summaries of the following information to the Management Review Committee:

- Listing of incidents of regulatory non-compliance
- Listing incidents of adverse drinking-water tests
- The efficacy of the risk assessment process
- Results of any relevant internal and third-party audits
- Results of emergency response testing
- Summary / trending of operational performance (raw and treated water)
- Deviations from critical control point limits and response actions
- Status of action-items from last Management Review
- Summary of Commission Meeting minutes pertaining to the QMS scope
- Changes in process or management that may affect the QMS
- Summary of customer feedback
- Resources needed to maintain the QMS
- Results of the infrastructure review
- Summary of the Operational Plan currency, content and updates
- Staff suggestions

4.4 The Management Review Committee shall review and discuss all information presented. The Committee shall make recommendations and initiate an action plan, as appropriate, to improve the content and implementation of the Operational Plan and related procedures, and to ensure the provision of adequate resources. The action plan will outline the personnel responsible for delivering the action items and the proposed timelines for the implementation.

4.5 Minutes of management review meetings shall be maintained by the QMS Representative or Alternate. The minutes shall document all new and outstanding action items as well as any decisions made by the Committee.

4.6 The QMS Representative and Alternate shall be responsible for communication and implementation of the management review action items. The QMS Representative or alternate will provide the minutes of management review meetings to the Chief Administrative Officer within three weeks of the Management Review.

5.0 Associated Documents

- *Communications Procedure GEN-P9*
- *Internal Audit Procedure GEN-P6*
- *Drinking Water Quality Management Standard*

Model Operational Plan - B

Description

A distribution system that purchases water from a separate water board.

Ownership

The distribution system is owned by the municipality.

Operating Authority

The distribution system is operated by the municipality.

Note: **Some procedures referenced in the following operational plan may not be included.**

Municipality of West Chester
Water Distribution System

Drinking Water Quality Management System
Operational Plan

Approved and Authorized for Use:

Mayor	Date
Public Works Superintendent	Date

Revision 1-May 1, 2007

MUNICIPALITY OF WEST CHESTER DISTRIBUTION SYSTEM DRINKING WATER QUALITY MANAGEMENT SYSTEM OPERATIONAL PLAN

Table of Contents

1. QUALITY MANAGEMENT SYSTEM

This document is the drinking water Quality Management System (QMS) Operational Plan for the West Chester Distribution System. The West Chester Distribution System (DS) is owned and operated by the Municipality of West Chester.

The QMS for the West Chester DS covers the transmission and distribution of potable drinking water to consumers within the Municipality of West Chester.

Treated potable drinking water is purchased from the Clear Lake Water Treatment Plant (CLWTP) which is owned by the Clear Lake Board of Management and is operated by Canadian Utility Operations Inc. The Municipality of West Chester is a board member and part owner of the supplying system, the CLWTP. The water enters the West Chester DS from two take-off points on the main CLWTP transmission line.

The Municipality of West Chester, in turn, supplies potable drinking water to the East Chester Distribution System from one take-off point within the West Chester DS.

2. QUALITY MANAGEMENT SYSTEM POLICY

The Municipality of West Chester is committed to comply with all applicable legislative and regulatory requirements to supply safe drinking water to meet the consumers' requirements and is committed to the maintenance and continual improvement of the Quality Management System.

3. COMMITMENT AND ENDORSEMENT

Owner (Mayor) and Top Management (Public Works Superintendent) endorsement of the Operational Plan is demonstrated by the signatures on the cover of the Operational Plan.

Both the owner and top management will review revisions to the Operational Plan at least 90 days prior to a management review or submitting the Operational Plan for an external audit.

4. QUALITY MANAGEMENT SYSTEM REPRESENTATIVE

The Certified Foreman will be the QMS representative. In his absence, the Certified Foreman will delegate another Foreman to be the alternate.

The QMS representative will develop, implement and maintain processes and procedures needed for the QMS. In addition, the QMS representative will report the effectiveness of the QMS, including the need for improvement, to Top Management (the Public Works Superintendent) and ensure that the current versions of the documents

required by the QMS are in use at all times. The QMS representative will promote the QMS throughout the Water Department and see that personnel are aware of all current regulatory and legislative requirements that are relevant to the operation of the distribution system.

5. DOCUMENT AND RECORDS CONTROL

All records required by the Ministry of the Environment Ontario Regulations 128/04 and 170/03, as amended, to demonstrate compliance shall be maintained per the regulations.

All material received is initialed after reviewing, acted upon if needed, filed in labeled folders in a file cabinet, or placed in a binder and retained as per the *Document and Record Control* procedure. See **PROCEDURE A.**

6. DRINKING WATER SYSTEM

The Municipality of West Chester is the owner and operator of the West Chester DS which services approximately 3,800 consumers (35-40% rural and 60-65% urban). It is their goal to supply safe drinking water to their customers at all times. As shown on the organizational structure, the Mayor and Council are the head of the Municipality, and this responsibility is delegated to the staff. See **ANNEX A** for the organizational structure.

The West Chester DS includes two reservoirs with inline booster pumps. The West Chester DS provides water to the East Chester Distribution System, which is owned and operated by the Municipality of East Chester. See **ANNEX A-1** for a schematic of the distribution system.

The West Chester DS purchases water from the Clear Lake Board of Management which has been treated at the CLWTP. The Canadian Utility Operations Inc., who is the operating authority for the CLWTP, is responsible for sampling, testing and monitoring at the CLWTP. The Canadian Utility Operations Inc. has an on-line chlorine residual analyzer on the treated water leaving the CLWTP. The water as supplied by the CLWTP has sufficient chlorine to ensure that the regulatory requirements for chlorine residual are met within the West Chester DS and the East Chester DS, therefore, re-chlorination is not practiced within the West Chester DS.

The two reservoirs in the West Chester DS provide temporary storage for approximately 15 hours of normal use or 6 hours of fire flow conditions. In-line booster pumps are used at the reservoirs to increase the pressure within the system West Chester DS.

All customers within the system are metered and the meters are read on a quarterly basis. There is no discount within our system for large users. All bills are calculated on a cubic metre rate.

The sizing of the meters and ports at the take-off chambers controls capacity. Peak demands are very consistent. Daily peaks occur at approximately 7:00 a.m. and 5 p.m. year-round.

The only main challenge with the West Chester DS is in Ward 5 as this area is at a higher elevation and therefore requires additional pressure.

7 RISK ASSESSMENT

See **PROCEDURE B.**

8 RISK ASSESSMENT OUTCOMES

The outcomes of the risk assessment are provided below.

Activity or Process Step	Description of Hazard	Potential Result of Hazard	Comments	Available Monitoring & Control Measures	Emergency Procedure or Contingency Plan	Likelihood	Severity	Detectability	Total (High Risk CCP Threshold=7	CCP?
Source water (treated water - CLWTP)	Contamination of source water	Chemical or Biological contamination of source water	No control	Daily chlorine residual at Main Street reservoir by Mun. of West Chester On-line monitoring and notification by Canadian Utility Operations Inc. as part of CLWTP. Also, Park Avenue reservoir chlorine residual analyzer (discharge of reservoir) and Church Street reservoir chlorine residual analyzer (downstream of system) alarmed	Assess if reservoirs need to be isolated from supply. Communication essential with CLWTP – depends on levels/demands at other reservoirs and locations. Discuss water quality with Medical Officer of Health (MOH) and Ministry of the Environment (MOE) (should have been reported by CLWTP operators). Communicate boil water / drinking water advisory if issued by MOH. Monitor chlorine residuals at furthest sampling points (West Somerset, Mt Pleasant – gravity side) (Clover, Aberdeen & the boosted side) Conduct other sampling, as necessary. On-going discussions with CLWTP operator; see if water quality and / or system chlorine residual has been restored.	1	3	1	5	No (Below risk threshold for CCP)

Activity or Process Step	Description of Hazard	Potential Result of Hazard	Comments	Available Monitoring & Control Measures	Emergency Procedure or Contingency Plan	Likelihood	Severity	Detectability	Total (High Risk CCP Threshold=7	CCP?
Storage	Vandalism/ Terrorism	Chemical / Biological Contamination		Security fences, locked and alarmed gates / hatches Drive by visual checks daily, or every other day at a minimum	Contact police and contact MOH and MOE Spills Action Centre, if necessary. Communicate drinking water advisory if issued by MOH. Check chlorine residual. If necessary, take reservoir off-line. Conduct other sampling, as necessary.	1	3	3	7	No (No control at this point)
	Biofilm development, build-up of sludge in reservoir, rapid deterioration of chlorine residual	Biological contamination		Daily checks on outgoing chlorine residual to monitor for loss of chlorine residual. Camera inspections of reservoir. West Chester reservoir cleaning and re-disinfection procedures.	Cleaning as per procedure in Operations Manual.	2	1	2	5	No (Below risk threshold for CCP)
Pumping Facilities	Power Loss	Quantity / Quality		Standby Generator at CLWTP. Standby Generators for all pumping stations, with automatic transfer systems, PLC check and loop controller daily. No on-line notification. Feedback by agricultural consumers, visual checks.	Fuel supply for several days, fuel at other locations.	3	1	1	5	No (Below risk threshold for CCP)
	Vandalism/ Terrorism	Quantity - Chemical / Biological Contamination		Security fences, locked and alarmed gates / hatches. Drive by visual checks daily or every other day at a minimum.	Contact police and contact MOH and MOE Spills Action Centre, if necessary. If pumping capacity lost, reconfigure distribution system.	1	2	3	6	No (No control at this point)

Activity or Process Step	Description of Hazard	Potential Result of Hazard	Comments	Available Monitoring & Control Measures	Emergency Procedure or Contingency Plan	Likelihood	Severity	Detectability	Total (High Risk CCP Threshold=7	CCP?
	Failure of alarms and monitoring equipment, pumps (lightning)			Feedback by agricultural consumers.	Go to stations, override automatic, operate on manual.	3	1	1	5	No (Below risk threshold for CCP)
Distribution	Watermain break within distribution system	Quantity / Quality Low pressure / Back-siphoning Bacteriological or chemical contamination	No elevated distribution system storage; need to pump continuously from reservoirs and CLWTP.	Customer complaints; Low pressure or high flows, visual if at ground, no on-line indication, monitoring of flows from CLWTP. (daily checks at station) May not be aware of fire/break. Looping / twinning have improved ability to isolate areas and also maintain flow in event of breaks. Replacement of old watermains based on material, age. Mapping.	Repair; watermain disinfection procedures per Operations Manual, training. Repair parts etc. stocked, If necessary, communicate issuance of boil water advisory after consultation with MOH.	4	2	3	9	No (No control at this point)
	Loss of chlorine residual (secondary disinfection)	Biological contamination	Legislated under O. Reg. 170/03.	Daily residual testing at far end of system, weekly monitoring at locations in town, values are tracked & trended through Water Trax.	Flush the system to increase chlorine dosage and resample. Corrective actions required by O. Reg. 170/03. See “Low Chlorine Residual Procedure” in Operations Manual for corrective actions.	1	4	3i	8	Yes. Critical Limit set at 0.20 mg/L. Regulatory limit is 0.05 mg/L.

Activity or Process Step	Description of Hazard	Potential Result of Hazard	Comments	Available Monitoring & Control Measures	Emergency Procedure or Contingency Plan	Likelihood	Severity	Detectability	Total (High Risk CCP Threshold=7	CCP?
	Commissioning of new mains causing contamination.	Biological contamination		Follow procedures for disinfection of new watermains in Operations Manual. Check chlorine residual and conduct microbiological testing.	Follow corrective action per O. Reg. 170/03. If necessary, communicate issuance of boil water advisory after consultation with MOH.	1	2	1	4	No (Below risk threshold for CCP)
	Loss of pressure – watermain break, major fire.	Quantity / Quality Low pressure / Back-siphoning Bacteriological or chemical contamination		Water hammer, consumer complaints. Backflow contamination prevented by 2" double check valves on all connections of concern. Backflow & PRV required (residential & commercial) through by-law passed Dec. 2005. 80% complete.	Check pressure and chlorine residual. Discussions with MOE and MOH if low. If necessary communicate issuance of boil water advisory after consultation with MOH. Restore pressure and chlorine residual. Conduct sampling per MOH and MOE direction.	1	2	1	4	No (Below risk threshold for CCP)
	Backflow from private plumbing (Cross connection)	Biological and chemical contamination	Backflow preventors on all connections of concern.	Meters are installed throughout. Backflow & PRV required (residential & commercial) through by-law passed Dec. 2005. 80% complete. Changing to radio reading system, installations of devices will be inspected at the same time. Operations staff to inspect.	Notify MOH and MOE Spills Action Centre. If necessary, communicate issuance of boil water or drinking water advisory after consultation with MOH. Isolate area. Flush the system and sample as appropriate. Inspect homes / commercial properties in area, install backflow preventors,	1	2	3	6	No (Below risk threshold for CCP)

Activity or Process Step	Description of Hazard	Potential Result of Hazard	Comments	Available Monitoring & Control Measures	Emergency Procedure or Contingency Plan	Likelihood	Severity	Detectability	Total (High Risk CCP Threshold=7	CCP?
	Biofilms	Biological and quality		Visual inspection of pipe breaks, reduced flow in pipes, inability to maintain chlorine residual. Flushing and swabbing. Replacement of old watermains based on material, age, observations. Mapping		2	2	1	5	No (Below risk threshold for CCP)

In the case of responding to hazards / emergencies, all actions must be recorded in the West Chester DS Log Book as required by Ontario Regulation 128/04.

9. OPERATIONAL STRUCTURE, ROLES, RESPONSIBLITIES AND AUTHORITIES

The Public Works Superintendent will keep the operational structure, respective roles, responsibilities and authorities current, and will communicate this information to the owner and personnel. See **ANNEX B** and **ANNEX C.**

10. COMPETENCIES

The following table illustrates the competencies required by personnel whose duties directly affect drinking water quality.

Function	Required Competencies	Desired Competencies
Public Works Superintendent	-minimum Class II Distribution certification -min 10 yrs Class II operation -WHMIS -first aid (including CPR) -leadership training -confined spaces training -valid drivers license	-development of all capital and regular plans
Certified Foreman	-minimum Class II Distribution certification -min 10 yrs operations experience -WHMIS -confined spaces training -first aid (including CPR) -valid drivers license - thorough understanding of DWQMS and QMS	-leadership training
Foreman	-minimum Class II Distribution certification -min 5 yrs operations experience -WHMIS -confined spaces training -first aid (including CPR) -valid drivers license - thorough understanding of DWQMS and QMS	-leadership training
Operators	-Operator in Training (OIT) to Distribution Class 2 -internal auditor training -WHMIS -Confined Space training -first aid (including CPR) -valid drivers license	

The above competency requirements are ensured by the following:

- All new employees outlined above must provide evidence of certification and other competency requirements. All operator certificates are posted at the Water Department office.
- All new employees will undergo training under the Certified Foreman, including a review of the Operations Manual and Contingency / Emergency plans for the DS, a review of the QMS Operational Plan, and on-the-job training.

- All employees receive training which meets or exceeds the requirements of Ontario Regulation 128/04.
- Changes to the DS or to the QMS are communicated, as needed, to all Water Department staff by the Public Works Superintendent and the QMS Representative, respectively.

All records of training are maintained at the Water Department office as proof that the required training has been successfully completed. The Public Works Superintendent is responsible for ensuring that all identified training is completed.

11. PERSONNEL COVERAGE

The water department is staffed Monday through Friday, 8:30 am to 4:00 pm. The Public Works Superintendent is the primary ORO and the back-up ORO (Certified Foreman) is tracked through time sheets.

The 24/7 personnel coverage procedure shows how after hour emergencies are handled. The auto dialer bumps numbers until either the Superintendent or one of the foremen are contacted. See **PROCEDURE C**.

Level I Operators and OITs can work on their own with an OIC (Operator-In-Charge) being readily available by phone or radio. Other employees not licensed must have an OIC present. If required, sub-contractors are approved by the Public Works Superintendent and used at the discretion of the OIC.

In the effect of a strike, the non-union Superintendent and Certified Foreman will perform day-to-day operations and maintenance.

12. COMMUNICATION

The QMS Representative shall ensure the owner (Mayor and Council) is provided with a current copy of the Operational Plan. The QMS Representative shall keep the owner informed of any changes to the QMS, the adequacy of infrastructure requirements, the outcome on-going activities as a result of Management Review and other QMS issues, through regular quarterly meetings. Minutes of these meetings will be maintained by the QMS Representative and filed at the Water Department office.

Personnel will be informed of the QMS and any changes or updates to it through quarterly staff meetings with the QMS Representative. A current version of the Operational Plan is available for review by staff at the Water Department office.

Essential suppliers shall receive information regarding the QMS from the purchaser, if and when necessary.

Consumers are informed of the QMS and any significant changes by newsletters, flyers or handouts.

The QMS policy is posted at the Water Department office, the municipal office and at each of the storage reservoirs/pumping stations. It can also be viewed on the municipal web site.

13. ESSENTIAL SUPPLIERS AND SERVICES

Where applicable, supplies must meet AWWA and ANSI standards. Supplies are verified against the order requisition when received.

A list of suppliers and contractors has been developed and is provided below. The list includes primary and secondary suppliers / service providers for each essential supply / service. This list is reviewed annually by the Public Works Superintendent to ensure that it is current and up-to-date.

SUPPLIERS AND SERVICES

Supplier	Contact	Phone	Cell
Smith Utilities	Rick Smith	555-8945	555-4539
Drinking Water Products	Joe Thomson	555-8438	555-2679
Disinfection Chemical Supply	Susan Clark	555-8765	555-7436
CALIBRATOR CONTRACTORS			
General Scientific Instrument Services (chlorine analyzer)		555-9863	
Coulter Meter Services (meters)	Sarah Girdwood	555-4596	555-3297
CONTRACTORS			
Ken's Digging	Ken Robinson	555-3897	555-3976
TYR Construction	Troy Robertston	555-9456	555-3964
ELECTRICAL			
Ready Electric		555-6912	
Siemans		555-3976	
LABS			
MGP Laboratories	After hours	555-4697 555-8956	
Water Tests Inc.		555-4697	
OTHER			
CLWTP (24 hr)		555-7963	
Municipality of East Chester (24 hr)		555-4697	

14. REVIEW AND PROVISION OF INFRASTRUCTURE

The infrastructure for the West Chester DS consists of water distribution system, two reservoirs / booster stations and some monitoring equipment. The system is relatively

new and has not historically been in need of replacement / repairs. However, the Municipality of West Chester intends to erect a water tower by 2012 to assist in maintaining adequate pressure throughout the DS and to provide additional water storage.

The need for infrastructure will be communicated to the Public Works Superintendent on an as-needed basis. The need for infrastructure will be an agenda item for each quarterly meeting. The adequacy of infrastructure to operate and maintain the DS may be assessed based on Water Department staff suggestions, water quality trends and consumer complaints. The Public Works Superintendent will communicate to the owner, during the annual Management Review meetings, the infrastructure deemed necessary to operate and maintain the West Chester DS.

15. INFRASTRUCTURE MAINTENANCE, REHABILITATION AND RENEWAL

The following routine planned maintenance is conducted on the West Chester DS: annual valve inspection / exercising, fall / summer hydrant flushing, annual hydrant inspection, annual pressure testing, bi-annual leak detection, annual inspection of reservoirs, as well as the activities required for maintaining the booster stations as listed in the Preventative Maintenance binder at the Water Department office. All records are maintained at the Water Department Office in the appropriate binders using the forms maintained at the back of the binders. All planned maintenance is scheduled and communicated to staff by the Public Works Superintendent.

Watermain or other equipment replacement is conducted on an as-needed basis. As noted previously, the West Chester DS is relatively new so equipment replacement has not been required.

Unplanned maintenance is conducted as required. All unplanned maintenance activities are authorized by the acting ORO. All records are retained at the Water Department office.

Once per year, the Public Works Superintendent prepares a summary of the infrastructure maintenance, rehabilitation and renewal programs and specifically looks at unplanned maintenance work to determine if additional planned maintained is required. This summary will be communicated to the owner during the yearly Management Review meeting

16. SAMPLING, TESTING AND MONITORING

Sampling, testing and monitoring of the treated water produced at the CLWTP is conducted by Canadian Utility Operations Inc. operators as required by Ontario Regulation 170/03. The operators ensure that the water supplied to the West Chester DS meets the Ontario Drinking Quality Standards (ODWQS) and has a minimum free chlorine residual of at least 0.50 mg/L. The chlorine residual in water supplied to the West Chester DS by the CLWTP is typically around 1.0 mg/L. The Canadian Utility

Operations Inc. have an on-line chlorine residual analyzer on the treated water leaving the CLWTP and in the Rochester Distribution System, which is also provided water the CLWTP but is downstream of the take-off point for the West Chester DS.

Sampling and testing for the West Chester DS is limited to the distribution system as required by Ontario Regulation 170/03.

There are 6 chlorine residual kits within the municipality and 2 are kept at the Water Department office. One turbidity meter is at the Water Department Office and all air monitoring kits for confined spaces are in the vehicles. Sterile sample bottles are received from the laboratories and qualified operators are required to take courses as to the proper procedures for collecting the samples in the distribution system.

Free chlorine residuals are tested daily by a qualified operator at one of the two reservoirs (alternating between the locations) using a chlorine residual kit. Twelve (12) water samples are collected weekly from various locations throughout the Municipality per the sampling plan included in the Operations Manual. These samples are tested for E. Coli, total coliform and heterotrophic plate count (HPC) bacteria. Chlorine residuals are also tested manually by the operator at these sites at the same time that the microbiological samples are taken. A sample for trihalomethanes is collected once every three months in the DS from the sampling station at the dead end on MacKay Street. A sample is collected for lead once every 12 months from 52 Lennox Avenue, which is a location that is likely to have an elevated concentration of lead. All samples are submitted to MGP Laboratories in Toronto. Lab test results are reviewed by a certified operator and then entered into the Water Trax program by the office assistant when received. All chlorine residual results are recorded in the chlorine residual binder by the certified operator at the time of testing.

The laboratory will provide immediate oral notification to us of any adverse readings defined by Schedule 16 of O. Reg. 170/03. We, in turn, will provide immediate oral notification to the local Medical Officer of Health (MOH) and the Ministry of Environment (MOE) Spills Action Centre per Schedule 16 of Ontario Regulation 170/03 and record the names of the people spoken to and the details of the conversation. All records will be maintained in the West Chester DS log book. If an adverse test result defined by Schedule 16 of Ontario Regulation 170/03, is received and it has not been reported to the MOH or the MOE, we will immediately notify the MOH and the MOE as noted above. In addition, any free chlorine residual below 0.05 mg/L must be reported per Schedule 16 of Ontario Regulation 170/03.

If reported by the lab, within twenty-fours hours, the lab will send Section 1 of Notice of Adverse Test Results to us (if applicable). We will complete Section 2 (a) indicating the corrective action to be taken by the Municipality. These forms will be faxed to the MOH and MOE Spills Action Centre.

Once the corrective action has been taken as required by Schedule 17 of Ontario Regulation 170/03, Section 2 (b) will be completed and sent to the MOH and the MOE Spills Action Centre per Schedule 16 of Ontario Regulation 170/03.

These papers will then be filed in a properly labeled folder in a file cabinet at the Water Department and retained per Ontario Regulation 170/03.

The annual report will show all sample test results and any adverse readings. The report will be provided to the owner when complete, and will be made available to the public.

17. MEASUREMENT AND RECORDING

The portable chlorine analyzers and flow meters are calibrated by contractors according to the manufacturers' procedure annually. All calibrations are recorded and filed at the Water Department office.

Contractors used for performing calibrations are listed on the Supplier and Services list.

18. EMERGENCY MANAGEMENT

Some emergency situations / service interruptions that could occur include loss of power, contamination, transmission line or major watermain breaks, or interruptions in pressure. The Risk Assessment Outcomes in Section 8 can be referenced for emergency procedures or contingency plans.

In addition to the above, the Municipality of West Chester has an emergency plan in accordance with prevailing legislation and regulations which is updated annually at the municipal office. It is also kept at the Water Department office. A list of emergency contacts and essential suppliers and services is kept with the emergency plan.

The emergency contacts and essential suppliers and services list will be kept current by the Public Works Superintendent.

The responsibilities of all positions within the municipality during an emergency are listed in the municipal emergency plan, as is the emergency communication protocol.

If there is a water problem after hours, the caller will call the municipal office and follow the prompts. The call will be directed to the person on call and the problem will be investigated promptly.

All water department staff are required to review the emergency plans annually. In addition, desk top simulations will be practiced annually to keep all water personnel up to date on the emergency procedures.

19. INTERNAL AUDIT

All sections of the QMS will be subject to an internal audit at least once every twelve months and at least one month before the annual Management Review. See **PROCEDURE D.**

20. MANAGEMENT REVIEW

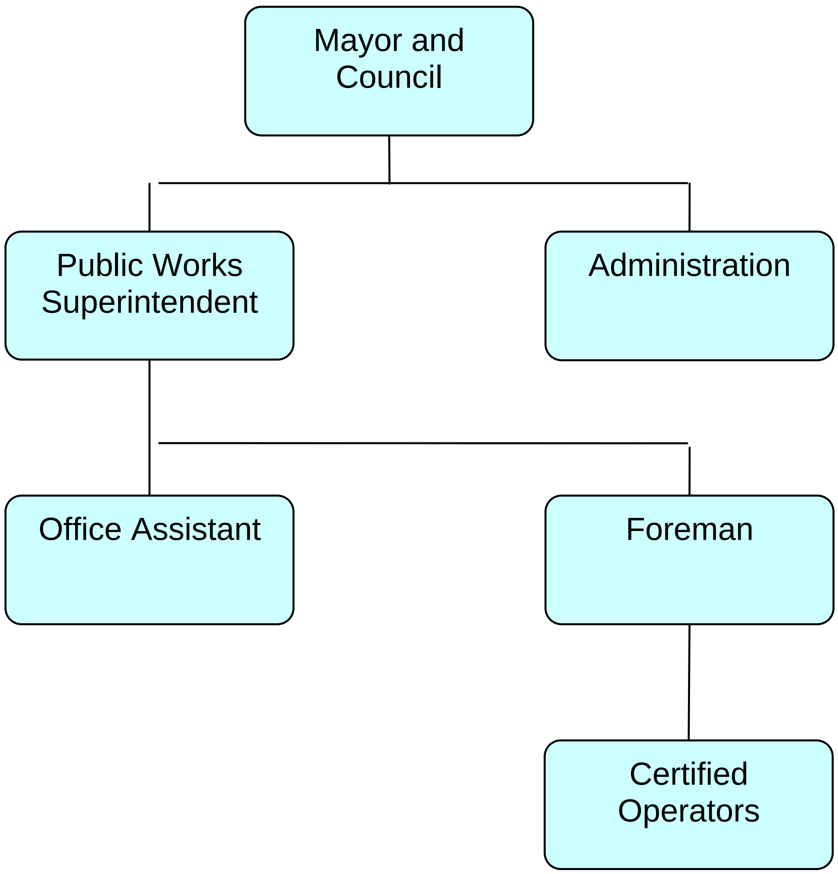
A Management Review will be completed annually with the Top Management (Public Works Superintendent), the owner (Mayor), and QMS Representative (Certified Foreman) to evaluate the continually suitability, adequacy and effectiveness of the QMS. See **PROCEDURE E.**

21. CONTINUAL IMPROVEMENT

The Municipality of West Chester shall strive to continually improve the effectiveness of its QMS through the use of corrective actions from the annual audits, staff suggestions and management reviews.

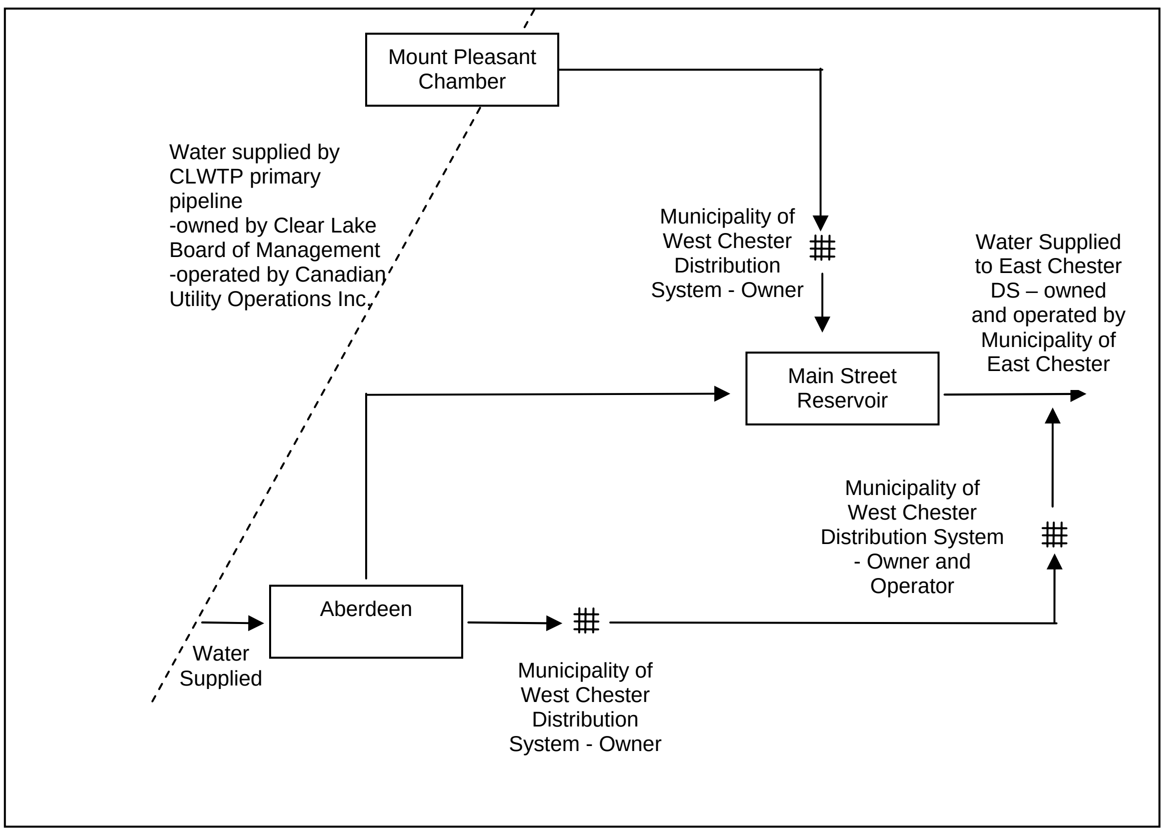
ANNEX A

ORGANIZATIONAL STRUCTURE



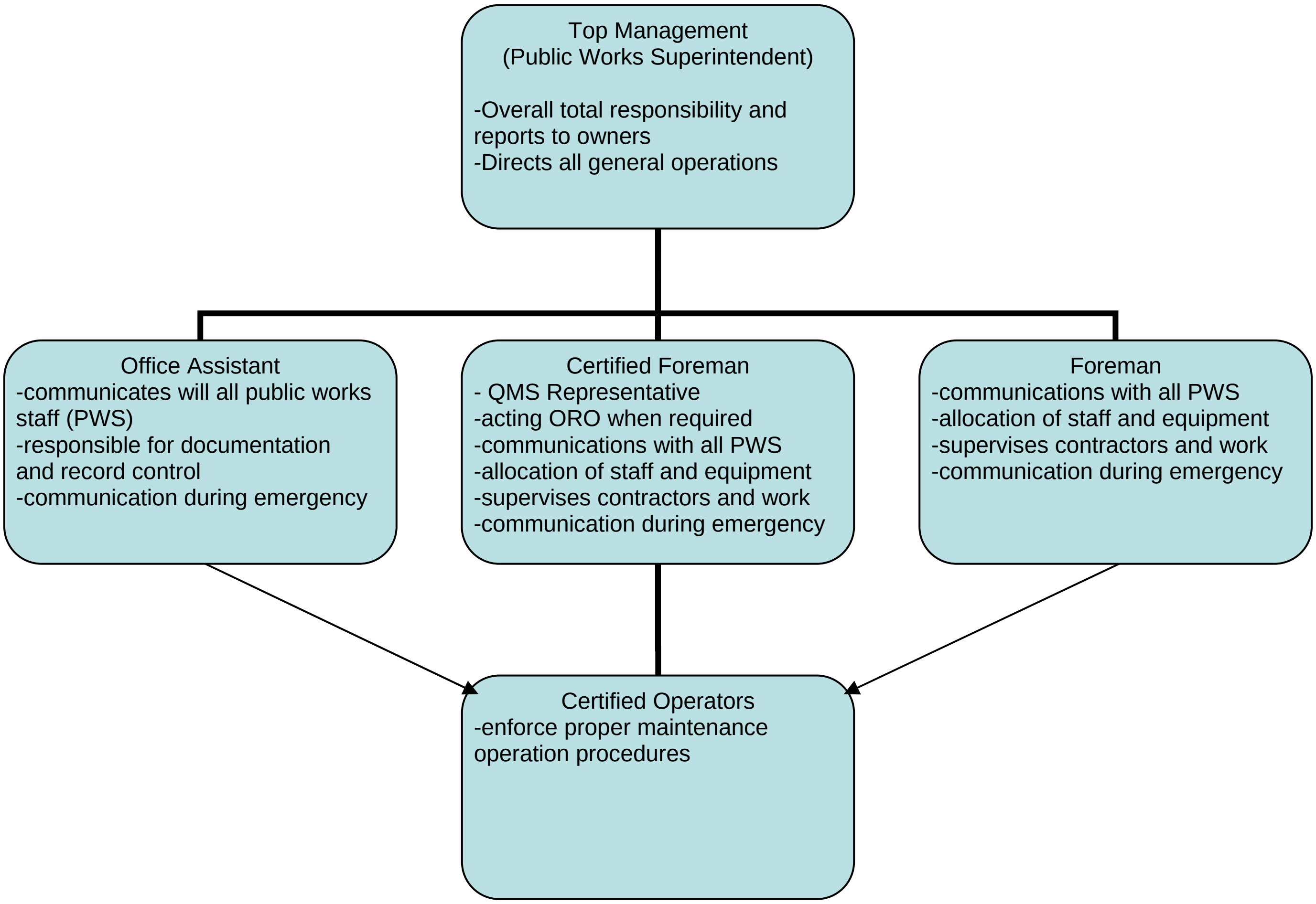
ANNEX A-1

WEST CHESTER DISTRIBUTION SYSTEM SCHEMATIC



ANNEX B

OPERATIONAL STRUCTURE



ANNEX C

OPERATIONAL ROLES, RESPONSIBILITES AND AUTHORITIES

Mayor/Council (Owner)

Responsibilities	Authorities
-Complete oversight of the entire distribution system and the QMS -Ultimate responsibility for the provision of safe drinking water -Ensure compliance with applicable legislation and regulations	-financial, administrative authority related to the distribution of safe drinking water.

Public Works Superintendent (Top Management)

Responsibilities	Authorities
-Complete oversight of the entire distribution system and QMS -ORO -provide and/or obtain resources for the QMS and necessary infrastructure and resources to operate and maintain the drinking water system safely and effectively -ensure the system is operated in accordance with all applicable legislation and regulations -lead for undertaking management reviews -communication with mayor and council about the QMS and the water distribution system -preparation of budget and planning materials -works with foremen on annual assessments of operator personnel performance -recommendation of system improvements - develop procedures and processes for assuring water quality -emergency response planning, training	-financial, administrative and technical authority related to the distribution of safe drinking water to the Municipality of West Chester -staffing-within the guidelines of the Municipality and any in-force collective agreements -activity/program scheduling within the department -oversee adverse water quality incidents and responses -identify and oversee staff training needs -delegate ORO to certified foreman in absence

Certified Foreman

Responsibilities	Authorities
-responsibilities of QMS Representative, outlined in Section 4 of Operational Plan -schedule and oversee the day-to-day activities relating to the water distribution system -communication/liaison with Superintendent, foreman and office assistant -act on and report any incidents of non-compliance -works with Superintendent on annual assessments of operators performance -develop procedures and processes for assuring water quality -ORO in the absence of the Superintendent	-make changes to the QMS -direct operators in day-to-day operation and maintenance of water distribution system -oversee adverse water quality incidents and responses -orders day-to-day supplies as needed - ORO responsibilities in absence of Superintendent -attend council meetings as required.

Foreman

Responsibilities	Authorities
-QMS Representative responsibilities in absence of Certified Foreman - schedule the day-to-day activities relating to maintenance of the water distribution system -communication/liaison with Superintendent, foreman and office assistant -works with Superintendent on annual assessments of operators' performance -has input into the development of procedures and processes for assuring water quality	-direct operators in day-to-day maintenance of water distribution system -orders day-to-day supplies as needed -attend council meetings as required -recommend changes to QMS

Office Assistant

Responsibilities	Authorities
-communication/liaison with Superintendent, foremen, operators -respond to and document public complaints -input lab results into Water Trax -prepare reports as required by regulations and circulate to management and council -documentation and record control for QMS -communication during emergency	-recommend changes to QMS -update and document changes to QMS

Operators

Responsibilities	Authorities
-weekly testing of drinking water -regular maintenance -report any incidents of non-compliance -respond to repairs	- recommend changes to QMS - monitor process and equipment - respond to public complaints as relayed from Superintendent, foremen or office assistant

ANNEX D

DWQMS CHECKLIST

DWQMS CHECKLIST

Form Approval (QMS Representative Signature):_________________________

Requirement	Notes, Observations and Audit Evidence	Conformance?	Records or Documents Reviewed, Interviews Conducted
THIS CHECKLIST IS BASED ON THE OCTOBER 2006 FINAL VERSION OF THE DRINKING WATER QUALITY MANAGEMENT SYSTEM (DWQMS)			
PLAN AND DO elements of the Quality Management Standard **1. Quality Management System** PLAN – The Operational Plan shall document a Quality Management System that meets the requirements of this Standard. DO – The Operating Authority shall establish and maintain the Quality Management System in accordance with the requirements of this Standard and the policies and procedures included in the Operational Plan.			
2. Quality Management System Policy PLAN – The Operational Plan shall document a Quality Management System Policy that provides the foundation for the Quality Management System, and: a.) is appropriate for the size and type of the subject system, b.) includes a commitment to the maintenance and continual improvement of the Quality Management System, c.) includes a commitment to the consumer to provide safe drinking water, d.) includes a commitment to comply with applicable legislation and regulations, and e.) is in a form that provides for ready communication to all Operating Authority personnel, the Owner and the public. DO – The Operating Authority shall establish and maintain a Quality Management System that is consistent with the Policy.			
3. Commitment and Endorsement PLAN – The Operational Plan shall contain a written endorsement of its contents by Top Management and the Owner.			

Requirement	Notes, Observations and Audit Evidence	Conformance?	Records or Documents Reviewed, Interviews Conducted
DO – Top Management shall provide evidence of its commitment to an effective Quality Management System by: a.) ensuring that a Quality Management System is in place that meets the requirements of this Standard, b.) ensuring that the Operating Authority is aware of all applicable legislative and regulatory requirements, c.) communicating the Quality Management System according to the procedure for communications, and d.) determining, obtaining or providing the resources needed to maintain and continually improve the Quality Management System.			
4. Quality Management System Representative PLAN – The Operational Plan shall identify a Quality Management System representative. DO – Top Management shall appoint, authorize and maintain a Quality Management System representative who, irrespective of other responsibilities, shall: a.) administer the Quality Management System by ensuring that processes and procedures needed for the Quality Management System are established and maintained, b.) report to Top Management on the performance of the Quality Management System and any need for improvement, c.) ensure that current versions of documents required by the Quality Management System are being used at all times, d.) ensure that personnel are aware of all applicable legislative and regulatory requirements that pertain to their duties for the operation of the subject system, and e.) promote awareness of the Quality Management System throughout the Operating Authority.			
5. Document and Records Control PLAN – The Operational Plan shall document a procedure for document and records control that describes how:			

Requirement	Notes, Observations and Audit Evidence	Conformance?	Records or Documents Reviewed, Interviews Conducted
a.) documents required by the Quality Management System are: i. kept current, legible and readily identifiable ii. retrievable iii. stored, protected, retained and disposed of, and b.) records required by the Quality Management System are: i. kept legible, and readily identifiable ii. retrievable iii. stored, protected, retained and disposed of. DO – The Operating Authority shall implement the procedure for document and records control and shall ensure that the Quality Management System documentation for the subject system includes: a.) the Operational Plan and its associated policies and procedures, b.) documents and records determined by the Operating Authority to ensure the effective planning, operation and control of its operations, and c.) the results of internal and external audits and management reviews.			
6. Drinking-Water System PLAN – The Operational Plan shall document, as applicable: a.) for the subject system: i. a description of the system including all treatment processes and distribution system components ii. the name of the Owner and Operating Authority iii. a process flow chart iv. a description of the water source, including: i. general characteristics of the raw water supply ii. common event-driven fluctuations and iii. any resulting operational challenges and threats v. a description of any critical upstream or downstream processes relied upon to ensure the provision of safe drinking water. b.) if the subject system is an operational subsystem, a summary description of the municipal residential drinking-water system is a part of. c.) If the subject system is connected to one or more other drinking-water systems owned by different owners, a summary description of those			

Requirement	Notes, Observations and Audit Evidence	Conformance?	Records or Documents Reviewed, Interviews Conducted
systems which: i. indicates whether the subject system obtains water from or supplies water to those systems, and ii. names the Owner and Operating Authority of those systems DO – The Operating Authority shall ensure that the description of the drinking-water system is kept current.			
7. Risk Assessment PLAN – The Operational Plan shall document a risk assessment process that: a.) identifies potential hazardous events and associated hazards, b.) assesses the risks associated with the occurrence of hazardous events, c.) ranks the hazardous events according to the associated risk, d.) identifies control measures to address the potential hazards and hazardous events, e.) identifies critical control points f.) identifies a method to verify once a year, the currency of information and the validity of the assumptions used in the risk assessment g.) ensures that a risk assessment is conducted at least once every thirty-six months, and h.) considers the reliability and redundancy of equipment. DO – The Operating Authority shall perform a risk assessment consistent with the documented process.			
8. Risk Assessment Outcomes PLAN – The Operational Plan shall document: a) the identified potential hazardous events and associated hazards, b) the assessed risks associated with the occurrence of hazardous events, c) the ranked hazardous events, d) the identified control measures to address the potential hazards and hazardous events, e) the identified critical control points and their respective critical control limits,			

Requirement	Notes, Observations and Audit Evidence	Conformance?	Records or Documents Reviewed, Interviews Conducted
f) procedures and/or processes to monitor the critical control limits, g) procedures to be undertaken in response to deviations from the critical control limits, and h) procedures for reporting and recording deviations from the critical control limits. DO – The Operating Authority shall implement and conform to the procedures.			
9. Organizational Structure, Roles, Responsibilities and Authorities PLAN – The Operational Plan shall: a) describe the organizational structure of the Operating Authority including respective roles, responsibilities and authorities, b) delineate corporate oversight roles, responsibilities and authorities in the case where the Operating Authority operates multiple subject systems, c) identify the person, persons or group of people within the management structure of the organization responsible for undertaking the Management Review, d) identify the person, persons or group of people, having Top Management and responsibilities required by this Standard, along with their responsibilities, and e) identify the owner of the subject system DO – The Operating Authority shall keep current the description of the organizational structure including respective roles, responsibilities and authorities, and shall communicate this information to Operating Authority personnel and the Owner.			
10. Competencies PLAN – The Operational Plan shall document: a.) competencies required for personnel performing duties directly affecting drinking water quality, b.) activities to develop and maintain competencies for personnel performing duties directly affecting drinking water quality, and c.) activities to ensure that personnel are aware of the relevance of their duties and how they affect safe drinking water.			

Requirement	Notes, Observations and Audit Evidence	Conformance?	Records or Documents Reviewed, Interviews Conducted
DO – The Operating Authority shall undertake activities to: a.) meet and maintain competencies for personnel directly affecting drinking water quality and shall maintain records of these activities, and b.) ensure that personnel are aware of the relevance of their duties and how they affect safe drinking water, and shall maintain records of these activities.			
11. Personnel Coverage PLAN – The Operational Plan shall document a procedure to ensure that sufficient personnel meeting the identified competencies are available for duties that directly affect drinking water quality. DO – The Operating Authority shall implement and conform to the procedure			
12. Communications PLAN – The Operational Plan shall document a procedure for communications that describes how the relevant aspects of the Quality Management System are communicated between Top Management and: a.) the Owner, b.) Operating Authority personnel, c.) Suppliers, and d.) the public. DO – The Operating Authority shall implement and conform to the procedure.			
13. Essential Supplies and Services PLAN – The Operational Plan shall: a.) identify all supplies and services essential for the delivery of safe drinking water and shall state, for each supply or service, the means to ensure its procurement, and b.) include a procedure by which the Operating Authority ensures the quality of essential supplies and services, in as much as they may affect drinking water quality.			

Requirement	Notes, Observations and Audit Evidence	Conformance?	Records or Documents Reviewed, Interviews Conducted
DO – The Operating Authority shall implement and conform to the procedure.			
14. Review and Provision of Infrastructure PLAN – The Operational Plan shall document: a procedure for the annual review of the adequacy of the infrastructure necessary to operate and maintain the subject system. DO – The Operating Authority shall implement and conform to the procedure and communicate the findings of the review to the Owner.			
15. Infrastructure Maintenance, Rehabilitation and Renewal PLAN – The Operational Plan shall document a summary of the Operating Authority's infrastructure maintenance, rehabilitation and renewal programs for the subject system. DO – The Operating Authority shall: a.) keep the summary current, b.) communicate the programs to the Owner, and c.) monitor the effectiveness of the maintenance program.			
16. Sampling, Testing and Monitoring PLAN – The Operational Plan shall document: a.) a sampling, testing and monitoring procedure for process control and finished drinking water quality including requirements for sampling, testing and monitoring at the conditions most challenging to the subject system, b.) a description of any relevant sampling, testing or monitoring activities that take place upstream of the subject system, and c.) a procedure that describes how sampling, testing and monitoring results are recorded and shared between the Operating Authority and the Owner, where applicable. DO – The Operating Authority shall implement and conform to the procedures.			

Requirement	Notes, Observations and Audit Evidence	Conformance?	Records or Documents Reviewed, Interviews Conducted
17. Measurement and Recording Equipment Calibration and Maintenance PLAN – The Operational Plan shall document a procedure for the calibration and maintenance of measurement and recording equipment. DO – The Operating Authority shall implement and conform to the procedure.			
18. Emergency Management PLAN – The Operational Plan shall document a procedure to maintain a state of emergency preparedness that includes: a.) a list of potential emergency situations or service interruptions, b.) processes for emergency response and recovery, c.) emergency response training and testing requirements, d.) Owner and Operating Authority responsibilities during emergency situations, e.) references to municipal emergency planning measures as appropriate, and f.) an emergency communication protocol and an up-to-date list of emergency contacts. DO – The Operating Authority shall implement and conform to the procedure.			
CHECK elements of the Quality Management Standard **19. Internal Audits** PLAN – The Operational Plan shall document a procedure for internal audits that: a.) evaluates conformity of the QMS with the requirements of this Standard, b.) identifies internal audit criteria, frequency, scope, methodology and record-keeping requirements, c.) considers previous internal and external audit results, and			

Requirement	Notes, Observations and Audit Evidence	Conformance?	Records or Documents Reviewed, Interviews Conducted
d.) describes how Quality Management System corrective actions are identified and initiated. DO – The Operating Authority shall implement and conform to the procedure and shall ensure that internal audits are conducted at least once every twelve months.			
20. Management Review PLAN - The Operational Plan shall document a procedure for management review that evaluates the continuing suitability, adequacy and effectiveness of the Quality Management System and that includes consideration of: a.) incidents of regulatory non-compliance, b.) incidents of adverse drinking-water tests, c.) deviations from critical control point limits and response actions, d.) the efficacy of the risk assessment process, e.) internal and third-party audit results, f.) results of emergency response testing, g.) operational performance, h.) raw water supply and drinking water quality trends, i.) follow-up on action items from previous management reviews, j.) the status of management action items identified between reviews, k.) changes that could affect the Quality Management System, l.) consumer feedback, m.) the resources needed to maintain the Quality Management System, n.) the results of the infrastructure review, o.) Operational Plan currency, content and updates, and p.) staff suggestions. DO – Top Management shall implement and conform to the procedure and shall: a.) ensure that a management review is conducted at least once every twelve months, b.) consider the results of the management review and identify deficiencies and action items to address the deficiencies, c.) provide a record of any decisions and action items related to the management review including the personnel responsible for delivering the action items and the proposed timelines for their implementation, and d.) report the results of the management review, the identified deficiencies,			

Requirement	Notes, Observations and Audit Evidence	Conformance?	Records or Documents Reviewed, Interviews Conducted
decisions and action items to the Owner.			
IMPROVE element of the Quality Management Standard **21. Continual Improvement** DO - The Operating Authority shall strive to continually improve the effectiveness of its Quality Management System through the use of corrective actions.			

ANNEX E

RISK ASSESSMENT FORM

RISK ASSESSMENT FORM

Risk Assessment Date:
Risk Assessment Team:
Form Approval (QMS Representative signature):

Activity or Process Step	Description of Hazard	Potential Result of Hazard	Comments	Available Monitoring & Control Measures	Emergency Procedure or Contingency Plan	Likelihood	Severity	Detectability	Total (High Risk CCP Threshold=7	CCP?

RISK ASSESSMENT FORM

Activity or Process Step	Description of Hazard	Potential Result of Hazard	Comments	Available Monitoring & Control Measures	Emergency Procedure or Contingency Plan	Likelihood	Severity	Detectability	Total (High Risk CCP Threshold=7	CCP?

PROCEDURE A

DOCUMENT AND RECORD CONTROL

QMS Document Control

This procedure is applicable to the following QMS documents:

- Operational Plan and associated procedures
- QMS Forms
- Equipment Manuals
- As Built Drawings
- Applicable drinking water regulations (O. Reg. 170/03 and O. Reg. 128/04)

<u>Creating New or Updating Existing Documents</u>

- The need for document changes or for new documents may be identified through audits or Management Reviews. The QMS Representative will delegate the task of creating the new document.

- Any employee of the Water Department may request a change to an existing QMS document. The request must be made in writing, dated and submitted to the QMS Representative. The request must include the following information:

  1. Reason for the new or changed document (one of the following needs to apply):
     - It is required by the DWQMS
     - It enhances process control
     - It reduces risk
     - It supports regulatory requirements
     - It may improve operational efficiency

  2. The proposed document change or new document content. Narrative format is acceptable.

- The requester shall develop the new/changed document and submit it to the QMS Representative for review. The QMS Representative shall review the procedure, make any changes as required, and approve it.
- Electronic versions of the new/changed documents will be created by the Office Assistant and approved by the QMS Representative.

<u>Approving Documents</u>

- All QMS related documents shall be approved by the QMS Representative.
- All QMS documentation shall be stored at the Water Department office on the central computer in the QMS folder and in hard copy in the QMS binder. The electronic version shall be password protected to restrict access to the Office Assistant and the QMS Representative. The QMS documentation is considered approved when the hard copy bears the signature of the QMS Representative.

- The QMS Representative shall be responsible for ensuring that copies of new or changed internal documents show the document title, revision number and the date modified, and the approving signature.
- The QMS Representative is responsible to ensure that new or changed documents are communicated and /or distributed to Water Department staff.
- Obsolete documents shall be collected, archived in labeled boxes and stored in the Water Department archives.

Reviewing Documents

- The Operational Plan and procedures shall be reviewed annually by the QMS Representative for applicability and relevance.

Document Availability

- The current copy of the Operational Plan, procedures and associated documents are retained in the QMS binder at the Water Department office.
- Original sets of equipment manuals / specifications and drinking water regulations are kept in binders at the Water Department office.
- Copies of As-Builts are stored in the filing drawers at the Water Department office.
- As appropriate, copies of these documents are also kept at the reservoirs and pumping stations.

QMS Record Control

This procedure is applicable to all records that demonstrate conformance to DWQMS requirements. All records that demonstrate compliance are covered by Ontario Regulations 170/03 and 128/04, as amended.

- QMS records shall be filed at the Water Department office by type by date.
- Records that are greater than 5 years in age shall be filed in labeled boxes and placed in the Water Department archives.
- QMS records shall be stored in such a manner as to prevent deterioration.

Manual Records

- The record title shall be clearly visible and legible.
- Manual records shall be legible. Pencil or any other erasable marker shall not be used to record process or product information or data.
- All manual records shall show the name or initials of the recorder and the date (and time if appropriate) the record was generated.

Water Trax

- Weekly sampling data and chlorine residuals are entered into the Water Trax program.
- Quarterly and annual reports are generated through the Water Trax program and are filed at the Water Department office.
- Water Trax is backed up weekly by the service provider.

PROCEDURE B

RISK ASSESSMENT AND OUTCOMES

The Public Works Superintendent, Certified Foreman and operators shall form a Risk Assessment Team to identify: the potential hazards and hazardous events which could affect the water system; the control measures to address the hazards; the Critical Control Points and control limits; and the associated methods of monitoring critical limits and responding to deviations. The *Risk Assessment Form,* provided in Annex E, is used to record the results of the risk assessment.

As the first step of the Risk Assessment, the Risk Assessment Team shall review hazards and hazardous events associated with the DS. The monitoring, control measures and emergency procedures or contingency plans which are available are identified. The risks associated with the hazards and hazardous events will then be assessed by the team on the basis of likelihood, severity and detectability, based on the tables below. The reliability and redundancy of equipment is considered when assigning ratings to the hazard and hazardous events.

Description	**Likelihood of Hazardous Event Occurring**	Rating
Rare	May occur in exceptional circumstances, and has not occurred in past	1
Unlikely	Could occur at some time, historically has occurred less than once every 5-10 years	2
Possible	Has occurred or may occur once or more per year	3
Likely	Has occurred or may occur on a monthly to quarterly basis	4
Very Likely	One or more occurrences on a monthly or more frequent basis	5

Description	**Severity of Hazardous Event Occurring**	Rating
Insignificant	Insignificant impact, little public exposure, little or no health risk	1
Minor	Limited public exposure, minor health risk	2
Moderate	Minor public exposure, minor health risk	3
Major	Large population at risk	4
Catastrophic	Major impact for large population, complete failure of systems	5

Description	**Detectability of Hazardous Event**	Rating
Very Detectable	Easy to detect, visual	1
Moderately Detectable	Increased flow rates	2
Normally Detectable	Visually detectable but not on rounds or regular basis	3
Poorly Detectable	Visually detectable but not inspected on a regular basis	4
Undetectable	Cannot detect	5

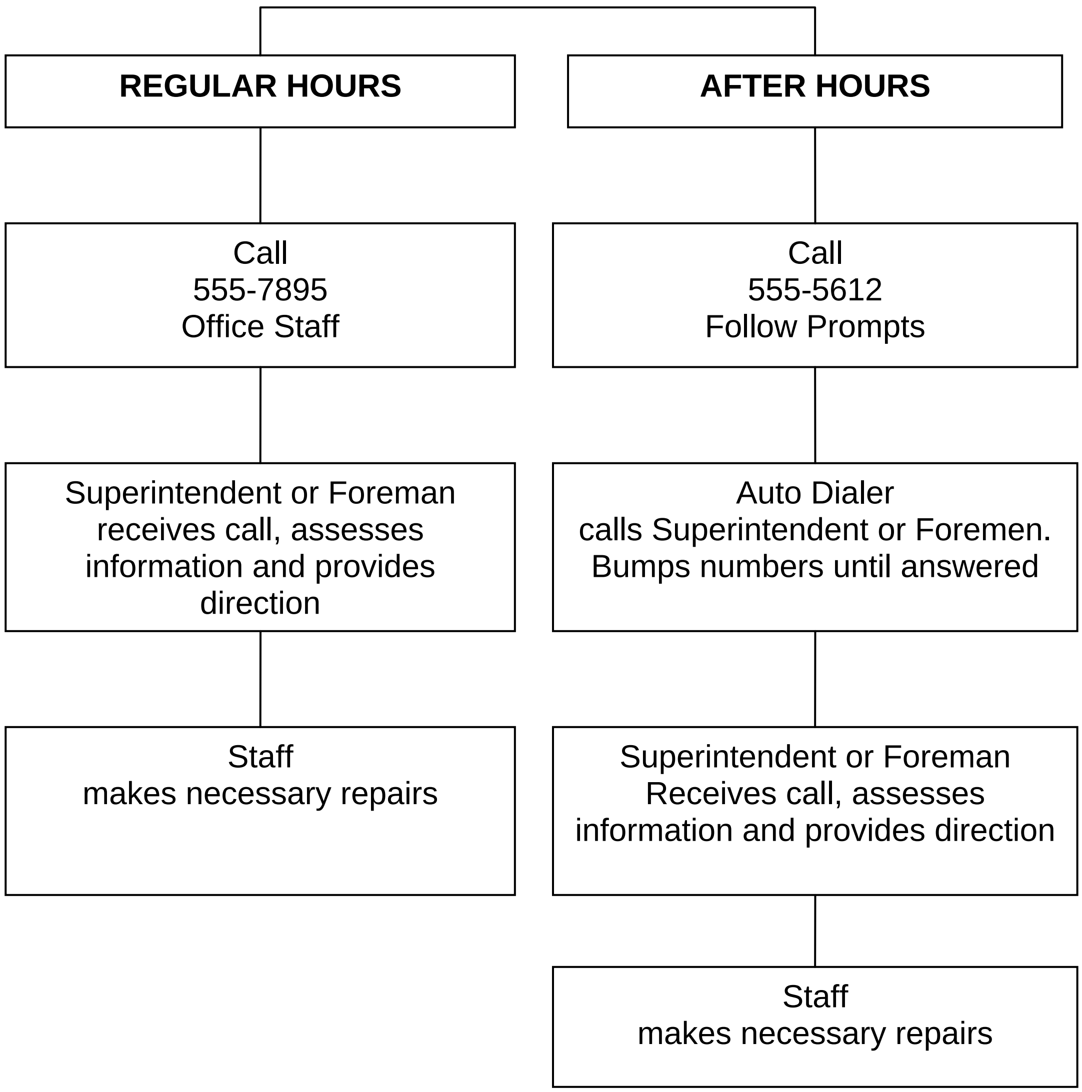
The rating for the likelihood, severity and detectability is then added to give an overall level of risk for each hazard or hazardous event. All hazards or hazardous events which have an overall risk rating of greater than 7 are considered critical and are associated with a critical control point.

Every year, the Public Works Superintendent will review the risk assessment and ensure that the information and assumptions remain current and valid.

Every 3 years the Public Works Superintendent will assemble the Risk Assessment Team to conduct a new risk assessment.

PROCEDURE C

PERSONNEL COVERAGE 24/7



PROCEDURE D

INTERNAL AUDIT

Internal audits will be conducted to ensure that the QMS conforms to the requirements of the DWQMS. These requirements include ensuring that the QMS has been effectively implemented and properly maintained.

The Municipality of West Chester may, from time-to-time, request that internal audits be conducted by trained auditors from a neighbouring municipality. In turn, the Municipality of West Chester may provide the same service to other municipalities as the case arises.

Audits Conducted by Municipality of West Chester

<u>Auditors</u>

- Internal audits will be conducted by an operator who has successfully completed a recognized minimum 16 hour Internal Auditor workshop.

<u>Internal Audit Schedule</u>

- Internal audits are scheduled throughout the year. The audits are scheduled by Element(s) for each month. The assigned auditor's name also appears on the schedule.

- The audit schedule is developed and published at the end of February each year for the upcoming fiscal year by the QMS Representative.

- Each element of the DWQMS is audited at least once during the fiscal year.

<u>Audit Planning</u>

- The auditor shall review all related QMS documentation and obtain the current version of the DWQMS checklist (see Annex D) at least one week prior to the audit.

<u>Conducting the Audit</u>

- The auditor shall observe activities, review records, review previous internal and external audit results, and interview personnel as necessary to ensure that the status of the audited element of the QMS has been effectively covered.

<u>Reporting the Results</u>

- The auditor shall submit a completed report, including the DWQMS checklist, to the QMS Representative and the Public Works Superintendent within 7 days of the internal audit.

- The report shall include any corrective actions requests (CARs) required to address discrepancies between the QMS and the DWQMS or between the QMS

and how it is actually implemented. Responses to CARs shall be designated to the responsible individual by the QMS Representative.

Audits Conducted by Another Municipality

Auditors

- Outside auditors must provide proof of competency prior to conducting an audit.

Audit Schedule

- Audits are to be conducted per the schedule noted above.

Planning and Conducting the Audit and Reporting the Results

- Audits may be planned and conducted per the procedures of the auditing municipality. The current version of the DWQMS checklist must be used during the audit and all sections of the DWQMS must be audited within the fiscal year. Prior approval by the QMS Representative is required.

- Audit results may be reported per the procedures of the auditing municipality as long as the audit results and any CARs are documented.

- The audit report, including any CARs will be provided to the QMS Representative and the Public Works Superintendent within 7 days of the internal audit. Responses to CARs shall be designated to the responsible individual by the QMS Representative.

PROCEDURE E

MANAGEMENT REVIEW

This procedure defines the Management Review process to evaluate the continuing suitability, adequacy and effectiveness of the QMS.

Review Frequency

Management Reviews shall be conducted at least once every 12 months, and prior to completion of the annual budget process.

Review Participants

The management review is convened by the Public Works Superintendent. Attendees shall include the Certified Foreman and the owner (Mayor).

Review Input

The QMS Representative and/or Public Works Superintendent shall provide information and data concerning the following categories, for the review:

- incidents of regulatory non-compliance
- incidents of adverse drinking water tests
- deviations from critical control point limits and response actions
- the efficacy of the risk assessment process
- results of internal and 3rd party audits
- results of relevant emergency response testing
- operational performance and water quality trends
- follow-up on actions items from previous management reviews
- status of management action items (if any) identified between reviews
- changes in resource requirements, infrastructure, process, personnel, the Drinking Water Quality Management Standard or regulations that could affect the QMS
- consumer feedback
- the resources needed to maintain the QMS
- the results of the infrastructure review
- Operational Plan currency, content and updates, and
- staff suggestions

Review Process

The Management Review shall be a planned event. A minimum of four hours shall be set aside by the participants to ensure a thorough review of the QMS is conducted.

Each input category shall be reviewed in order to identify if, where and when improvements to the QMS and its procedures are required.

The QMS Representative shall make note of any changes or action items required during the course of the review.

Review Output

The output from the Management Review shall include meeting minutes maintained by the QMS Representative. These minutes shall include:

- the date and time of the Management Review and the names of participants and attendees.
- Any identified deficiencies.
- A list of “action” items. All action items shall identify an individual responsible and the proposed timelines for implementation.
- Recommendation(s) for any resources needed for maintenance or improvement of the QMS.

The meeting minutes will be provided to the owner (Mayor) and the Public Works Superintendent within 30 days of the Management Meeting.

Model Operational Plan - C

Description

Groundwater supply treatment (multiple wells) and distribution system.

Ownership

The drinking water system is owned by the municipality.

Operating Authority

The municipality is the operating authority.

Note: **Some procedures referenced in the following operational plan may not be included.**

Town of Mountain Grove
Waterworks Department

Operational Plan

Prepared By:
Martin Aston
Water System Operator

Approved By:
Bill Craigson
Chief Operator

Issued:

Table of Contents

1. Overview

The Mountain Grove water system is owned and operated by the Town of Mountain Grove. The drinking-water system is not connected to any other drinking-water system.

Two groundwater wells with submersible pumps supply the Mountain Grove water system. Under normal circumstances, water is only pumped from Well No. 2 which is capable of meeting peak system demands. Well No. 1 serves as a back-up, and is also required to meet fire flows.

The raw water is disinfected with sodium hypochlorite and discharged to a clear well sized to meet CT requirements for 2-log disinfection of viruses. From the chlorine contact tank the water flows into the pump well in which two jockey pumps, two high lift pumps and one fire pump are located. One of the jockey pumps and one of the high lift pumps are standby in case the duty pump fails or is out of service for maintenance.

There is no storage in the Mountain Grove distribution system. During periods of low demand the jockey pump output exceeds system demand causing system pressure to build-up and the pressure relief valve to open. The pressure relief valve discharges back to the pump well.

The chlorine residual entering the clearwell is monitored by an on-line analyzer to ensure the chlorination system is working properly. Chlorine addition is paced to the flow of the well pumps. A second, regulatory chlorine residual analyzer monitors the free chlorine residual entering the distribution system. Both chlorine residual analyzers will alarm if their low or high setpoints are reached and the on-call operator will respond.

The chlorine residual can be “topped up”, if necessary, to maintain secondary disinfection. The dosage rate for the feed pumps is set manually by the operator.

The complete system includes monitoring for raw and treated water flow, chlorine residuals, system pressure, water levels, pump operation, building security, and electrical power. As appropriate, these are controlled by a SCADA system which is equipped with an uninterrupted power supply (UPS). The SCADA system is located at the Dale Road Pumphouse/Treatment facility. A standby diesel generator and fuel tank are also located at the pumphouse and will start automatically on loss of grid power.

The SCADA system is programmed to alarm for conditions such as low chlorine residual, low system pressure, pump failure (well, high lift, or sodium hypochlorite), security breaches, etc. The on-call operator determines the need for immediate response based on the nature of the alarm.

2. Quality Policy

Through this policy, the Town of Mountain Grove commits to:

- the provision of safe drinking water
- continual improvement of the QMS and the water works
- complying with relevant legislation and regulations
- *conducting business in an environmentally responsible manner (check note below)*.

This policy shall serve as the foundation of our drinking water quality management system. It will be communicated to all employees through orientation sessions (QMS and New Hire), internal posting and on all security swipe cards. It will be communicated to the public through posting of the policy in public areas of the Town Hall, on the Town of Mountain Grove web-site and through occasional mailings.

Note: This commitment goes beyond the requirements of the DWQMS and is not addressed further in this operational plan. The auditor however, will check that this commitment is being met.

3. Endorsement

This Operational Plan is endorsed and supported by the Town of Mountain Grove Mayor, Councillors and Chief Operator.

Charlotte Whitton
Mayor

Bill Craigson
Chief Operator

Don Reid
Councillor – Ward #1
(Water Committee Chairperson)

James Durrell
Councillor – Ward #2

Marion Dewar
Councillor – Ward #3

Dated this day, 13/May/2005.

4. QMS Representative

Please see Section 10 in this document.

5. Document & Records Control

5.1 QMS Document Control (Other than Records)

This procedure is applicable to the following QMS documents:

- Operational Plan
- Quality Policy
- Procedures
- Instructions
- Audit Checklists
- Forms
- Equipment Manuals
- As Built Drawings

<u>Creating New or Updating Existing Documents</u>

Any employee of the Water Department may request the creation of a new QMS document or a change to an existing one. The request must be made in writing and submitted to the QMS Representative. The need for new or updated documents may also be identified by audits or management review. The QMS Representative will be assigned the task of creating or revising these documents. The request must include the following information:

1. Reason for new or revised document - must belong in one or more of these categories:

   - Required by the DWQMS
   - Enhances process control
   - Eliminates risk
   - Supports regulatory requirements
   - May improve operational efficiency.

2. Outline of document change or new document content - narrative format is acceptable.

If approved, the requester shall develop the new/changed document and submit it to the QMS Representative for Approval.

The procedure template is available on-line. Please go to the Admin folder, select Templates and then click on QMS Procedure Template. The Template is “locked” so that it cannot be changed.

Approving Documents

All QMS related documents created by the Town of Mountain Grove Water Department shall be approved by the QMS Representative before release.

The QMS Representative shall be responsible for ensuring that copies of the new or changed document are distributed. Obsolete documents (due to changes) shall be collected and destroyed by the QMS Representative.

Reviewing Documents

The Operational Plan and procedures shall be reviewed annually for applicability and relevance.

Document Availability

All procedures, instructions, forms and checklists are retained in the QMS binders at the Water Treatment Plant and at the office of the QMS Representative.

Water treatment machinery and equipment manuals are retained at the treatment plant. They are stored alphabetically by equipment type in binders. Each binder contains a table of contents. The binders are kept in the top two drawers of the grey, locking four-drawer file cabinets.

Water treatment and distribution drawings, specifications and manuals are retained by the QMS Representative. These documents are filed in the appropriate cabinets (flat and vertical).

5.2 QMS Records Control

This procedure is applicable to all records that demonstrate conformance to DWQMS requirements. All records that demonstrate compliance are covered by Ontario Regulations 170/03 and 128/04.

All QMS records are retained for a minimum of 5 years. However, if a QMS record is also a requirement of O. Reg 128/04 and/or 170/03, then the retention time shall be as per the regulation. Once the record retention time has been reached, records shall be destroyed.

Manual Records

- All manual records shall only use approved QMS forms.
- The record title shall be clearly visible and legible.
- Manual records shall be legible. Pencil or any other erasable marker shall not be used to record process or product information or data.
- QMS records shall be filed by type by date.
- QMS related Water treatment and distribution records shall be stored and available at the water treatment plant.
- QMS records shall be stored in such a manner as to prevent deterioration.
- All manual records shall show the name or initials of the recorder and the date (and time if appropriate) the record was generated.

SCADA Records

- QMS SCADA records are backed up each day.
- Electronic copies of the QMS SCADA records are compiled monthly and stored in the Town safe for a minimum of five years.

- Printed copies of the SCADA monthly summaries may be circulated for management and management review purposes. These summaries shall be filed by the Operations Director if being retained for knowledge purposes.

6. Drinking-Water System

6.1 Water Source

The Town of Mountain Grove obtains its raw water from two drilled wells. The hydrogeological study completed for the First Engineers report confirmed that the wells are “true” groundwater and not under the influence of surface water. The wells penetrate a sand/gravel aquifer of glacial origin. The aquifer has a relatively short flow path that is typical of local flow systems. Characterization of the aquifer can be found as part of the Town of Mountain Grove’s Ground Water Source Protection Program.

The capture zone or recharge area is approximately 290 km^2. The aquifer itself is estimated to extend over an area of approximately 52.5 km^2. The outflow, or discharge, is to several streams and the Ardoch Wetlands that in turn feed into the Crow River. The maximum saturated thickness of the sand and gravel beds of the aquifer is just over 55 m, but generally ranges in depths from 32 m to 53 m. At present it is estimated that the aquifer can continuously produce up to 2,860 l/s of water.

The Town of Mountain Grove’s Ground Water Source Protection Program contains maps showing the 5, 10 and 20 year capture zones for the wells, and also contains detailed mapping of the potential “threats” to source water quality. Agricultural and forests are the primary land uses in the 20 year well capture zone. The Town of Mountain Grove, which uses private sewage disposal systems, is not situated in the capture zone. The source water is generally considered to be well protected.

6.2 Raw Water Characteristics

The chemistry of the water makes it highly suitable as a source for drinking water with all parameters well below the Ontario Drinking Water Quality Standards. Iron and manganese are present, but not in sufficient quantity to warrant filtration. Because of the depth and structure of the aquifer the water temperature is relatively constant, and the hydraulic conductivity is high, turbidity is low and pH is considered normal for groundwater systems.

The raw water consistently tests negative for total coliform and E. coli bacteria, confirming that the water is not under the influence of surface water.

	Temperature	pH	Turbidity
Average	7°C	7.4	.09
Range	5.4°C to 9.2°C	7.1 – 7.6	.06 - .15

Data collected over the last 15 years indicates that the water source is stable and consistent in terms of both quality and quantity. Other than private residential wells,

there are no other users taking water from the aquifer. There have been no challenges encountered, and none are anticipated.

6.3 Water Treatment

Dale Road Pumphouse/Treatment Facility

The Dale Road pumphouse/treatment facility is located adjacent to the supply wells. The original facility was constructed in 1968 with one 200mm supply well (Well No. 1). In 1994 the facility was upgraded and a second 300 mm well (Well No. 2) was constructed. Both wells are founded at a depth of 41m. The last upgrade was completed in 2003 to address issues raised in the First Engineers Report for the system. This upgrade included the addition of a second cell to the contact tank to ensure that the required chlorine contact times could be met under all flow conditions, upgrades to the SCADA systems, the addition of a standby diesel generator and the addition of a second on-line chlorine residual analyzer.

Well No. 2 (300mm) is the normal duty well. Well No.1 serves as a back-up in the event of maintenance or a mechanical or other failure in the duty well. Well No. 1 will also start-up if the fire pump goes into service.

The raw water is metered, chlorinated, mixed (static mixer) and analyzed for free chlorine residual before entering the clear well. Chlorine is added in the form of sodium hypochlorite. The feed system consists of a day tank with two chemical feed pumps (one duty and one standby).

As water in the clear well is depleted, a level indicator signals the well pump to refill the clear well. Once the well pump starts, the primary disinfection sodium hypochlorite pump also starts. The dosage is paced to the flow signal from the raw water flow meter. If both wells are operating, the dosage rate will automatically increase to account for the reduced contact time available in the clear well. The chlorine contact tank provides the necessary contact time for primary disinfection to achieve 2-log disinfection of viruses.

Water flows from the clear well into the pump well. There are five high lift pumps; two submersible jockey pumps (duty and standby), two vertical turbine high lift pumps (duty and standby) and one fire pump.

Water is pumped to the discharge header. The discharge header contains a pressure relief valve which, when activated, diverts processed water back to the clear well.

On-line equipment monitors and records treated water flow, turbidity, pressure and chlorine residual prior to entry to the distribution system. There is an auxiliary sodium hypochlorite addition point located after the chlorine residual analyzer where, if necessary, additional chlorine can be added to maintain secondary disinfection in the distribution system. The sodium hypochlorite feed system consists of a duty and standby feed pump and a day tank

The standby diesel generator is sized to run both well pumps, the high lift pumps and all essential station equipment. The SCADA system monitors the incoming power supply and will start the generator and trip the transfer switch if the loss of grid power is detected.

6.4 Water Distribution

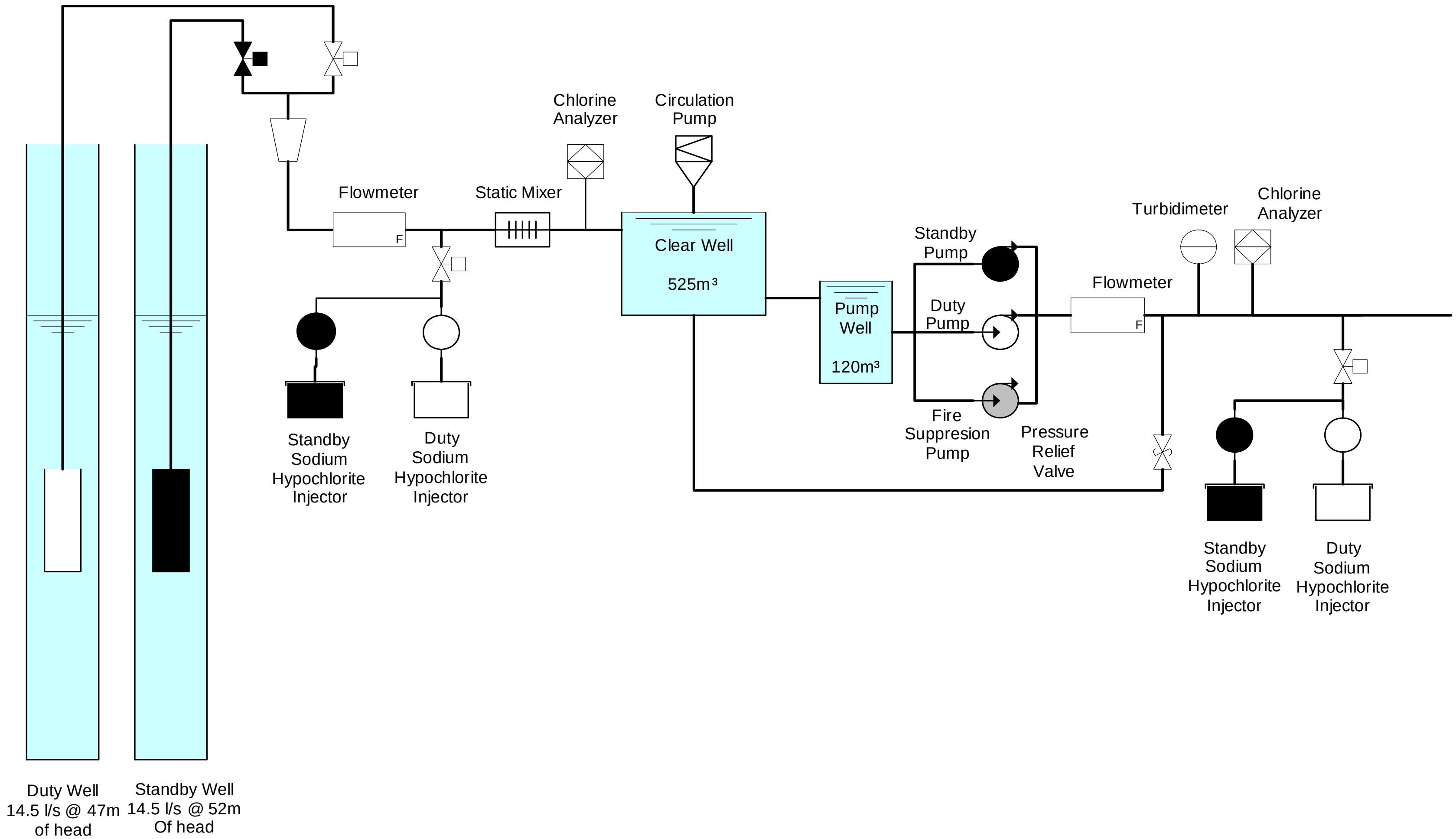
Processed water is pumped through 4.1km of 150mm mains to 166 service connections (153 Residential, 13 Commercial). The distribution system also includes 6 fire hydrants. Distribution system pressure is provided by the high lift pumps at the Dale Road facility.

There are 4 backflow prevention valves located within the distribution system at commercial/industrial facilities. Backflow preventers were added over the last 8 years purely as a preventive measure. The backflow prevention equipment is included in the regular maintenance/inspection program.

The pressure entering the distribution system typically varies from 50 to 70 psi, and is capable of maintaining pressure in the distribution system above 40 psi at all locations under peak flow conditions. During fire flows, system pressure may drop to 25 psi.

A process flow chart for the system is presented in Figure 6.1.

Figure 6.1: Mountain Grove Water Supply System Process Flow Chart



7. Risk Assessment

7.1 Overview

The following procedure shall be used to assess risks to the drinking water system.

In general, the procedure will:

- identify and rank potential hazards to the water system
- identify control measures to address hazards
- identify Critical Control Points (CCPs) and associated methods of monitoring and controlling them.

The results of the assessment shall include:

- A list of ranked hazards complete with:

    1. control measures where appropriate
    2. CCPs
    3. control limits for CCPs
    4. monitoring methods for CCPs

- A method for reporting and recording deviations from CCP limits.

7.2 Risk Assessment Procedure

1. The QMS Representative shall assemble a team to discuss and identify all potential hazards to the water works. The team members at a minimum shall include:

    - The QMS Representative
    - The Water Committee Chair
    - The Maintenance Contractor for Town of Mountain Grove
    - The WTP Foreman

2. Each of the process areas of the water works shall be reviewed to identify hazards. The process areas will include, but will not necessarily be limited to, the following:

    - Raw Water/Well
    - Primary Disinfection System
    - Clear well
    - Pump well (including pumps)
    - Secondary Disinfection System
    - Distribution
    - Control systems

- Facility security

3. Each hazard identified in Step 2 shall be "ranked" by the team as to their probability of actually occurring; what the impact (risk) would be, if they did occur, upon the raw water, the works, and the processed water; and how detectable the hazard is.

4. The total risk rank shall be determined by multiplying the individual scores for probability, severity, and detectability as defined by the table below.

Probability		Severity		Dectability	
1	**Rare** - requires exceptional circumstances to occur	**1**	**Insignificant** - little operational disruption	**1**	**High** - immediately detectable, SCADA alarms
2	**Unlikely** - Could occur at some point	**2**	**Minor** - impact of small portion of population, easily managed operationally	**2**	**Moderate -** indicated by alarm or lab results
3	**Possible** - Will occur at some point	**3**	**Moderate** - minor impact on large population, managed operationally	**3**	**Detectable** - visually detectable, rounds or maintenance
4	**LIkely** - Will occur during normal circumstances	**4**	**Major** - significant impact on population, difficult to manage	**4**	**Poor** - would not be detected until problem occurred
5	**Certain** - Expected to occur in most circumstances	**5**	Catastrophic - major impact on population, complete systems failure	**5**	**Undetectable** - cannot be detected under any circumstances

5. Once the rankings are determined, the team shall identify the control measures, the critical control points, and methods to monitor all. The team shall also identify where procedures are needed to respond to any deviations from established critical control limits.

6. The QMS Representative shall draft the response procedures for deviations to the critical response limits.

7. Following the conclusion of the Risk Assessment process and the implementation of all resulting procedures and measures, The Risk Assessment Team shall meet once a calendar year to review the validity of the assumptions and the currency of the information used in the risk assessment. A risk assessment will be conducted from scratch once every three years. Any changes to procedures shall be carried out by the QMS Representative.

8. All notes, meeting minutes, action items, and decisions shall be documented and keep as part of the file for the process.

9. The QMS representative shall ensure that relevant information is circulated to all members of the Risk Assessment Team.

8. Risk Assessment Outcomes

8.1 Critical Control Limits

The outcomes from the risk assessment process are documented in the tables on the following pages. The following were determined to be Critical Control Points in the Town of Mountain Grove drinking water system:

- Primary Disinfection
- Secondary Disinfection
- System Pressure

Control Limits have been established for the Critical Control Points. These Control Limits are within the regulatory limits set by the MOE. The control limits act a warning that adjustments to the treatment process may be required to prevent an adverse water condition incident. The control limits are outlined in the table below.

CCP	Condition	High Limit	Low Limit
Chlorination system – primary and secondary disinfection			
Entry to Clear well		1.25 mg/L	1.0 mg/L
Minimum for CT	Both clearwell cells in service		0.6 mg/L
	One clearwell cell in service		0.8 mg/L
Entry to distribution system		1.0	0.6 mg/L
Grab sample in distribution system			0.3 mg/L
System Pressure			
At point of entry to distribution system	Normal Operating Conditions	80 psi	50 psi
	Fire Pump running	80 psi	25 psi
In distribution system	Normal Operating Conditions	N/A	40 psi
	Fire Pump Running	N/A	20 psi

8.2 Primary and Secondary Disinfection

Primary Disinfection Critical Control Limits (After Static Mix):

- Low treated water SCADA alarm – 1.0 mg/L
- High treated water SCADA alarm – 1.25 mg/L

(see procedure for primary disinfection and contact time in Operations Manual – not included in this Operational Plan)

Secondary Disinfection Critical Control Limits – (Off discharge header):

- Low treated water SCADA alarm – 0.6 mg/L
- Distribution system grab sample – 0.3 mg/L
- High treated water SCADA alarm – 1.50 mg/L

The chlorine analyzers are programmed to alarm if the critical limits are reached. The alarm and the value are recorded in the digital SCADA files. The water treatment operator shall adjust the process as necessary to eliminate any potential risk to the drinking water and record all alarm and response details in the plant log book. Any adverse water quality incidents shall be reported and responded to as required by O. Schedules 16 and 17 of Reg. 170/03. All deviations shall be reported to the Chief Operator.

Hazard Ranking and Critical Control Point Determination				Detectable	Severity	Probable	Rank	Critical	
Process Step	**Hazardous event**	**Result**	**Control Measure(s)**						**Associated Procedure(s)**
Raw Water/Well	Well casing collapse	Loss of raw water	Back-up well and pump	1	1	3	3	No	Maintenance
	Well pump failure	Loss of raw water	Back-up well and pump	1	1	3	3	No	Maintenance
	Chemical spill	Contamination of aquifer	Monitor and sample Well Head Protection Plan	4	3	1	12	No	- Monitoring and Sampling. - Contamination of Aquifer emergency procedure.
	Agricultural run-off	Contamination of aquifer	Monitor and sample Well Head Protection Plan	3	3	2	18	No	- Monitoring and Sampling. - Contamination of Aquifer emergency procedure.
Primary Disinfection	Chemical feed pump failure	Loss of disinfection	Back-up feed system On-line monitoring and controls	1	5	3	15	Yes	- Maintaining Primary Disinfection procedure - Recommended minimum CCP -Restoring Primary Disinfection procedure
	Static Mixer failure	Improper disinfection	Regular maintenance inspections	2	2	1	4	No	Maintenance
Clear Well	Clear well out of service for maintenance, repair	Inadequate contact time for primary disinfection	Two cell clear well, increase dosage rate	1	3	1	3	No	- Maintenance - Maintaining Primary & Secondary Disinfection -Restoring Primary Disinfection procedure
Pump Well	Pump failure	Loss of treated water	Back-up pumps	1	3	2	6	No	Maintenance
	Pump failure	Loss of system pressure	Back-up pumps	1	4	3	12	Yes	- Maintenance - Pressure Loss Response procedure

Hazard Ranking and Critical Control Point Determination									
Process Step	**Hazardous event**	**Result**	**Control Measure(s)**	**Detectable**	**Severity**	**Probable**	**Rank**	**Critical**	**Associated Procedure(s)**
Secondary Disinfection	Chemical feed pump failure	Inadequate disinfection	Back-up feed system On-line monitoring and controls Primary disinfection	1	5	2	10	No	- Maintaining Primary and Secondary Disinfection procedure - Restoring Secondary Disinfection procedure
Distribution	Watermain break	Loss of system pressure Contamination of distributed water	Inventory of pipes, valves, etc. for repair	2	5	4	40	Yes	- Watermain repair and disinfection procedures - Emergency Procedure - Competencies
Distribution	Loss of chlorine residual	Contamination of distributed water	Distribution system maintenance Sampling and Monitoring	3	5	2	30	Yes	- Maintaining Primary and Secondary disinfection procedure - Restoring Secondary Disinfection procedure
Control Systems	Power failure	Loss of SCADA	UPS and back-up diesel generator set, system discs	1	4	2	8	No	Maintenance
Entire system	Power failure	Loss of treated water supply	Diesel generator set, automatic transfer switch	1	5	3	15	No	- Maintenance - Emergency Procedures
Facility Security	Vandalism Introduction of contaminant	Damage to equipment – inability to produce water Potential contamination	Locks, alarms, fence	1	3	1	3	No	- Monday to Friday Security Checks - Security Breach procedure

Loss of primary disinfection was included as a CCP despite having a rank less than 20, as it is a Minimum recommended CCP (MOE Guidance document).

8.3 System Pressure

- Low pressure SCADA alarm – 750kPa

Any deviation from the limits shall be recorded in the Operator's Daily Log and be reported to the Chief Operator. The on-call Operator shall respond to any of these alarm conditions and investigate the cause. CCP Response Procedures follow:

8.4 Low Limit Disinfection Response Procedure

- The operator shall determine if the alarm is the result of an analyzer failure, or is actually due to a Low Chlorine reading. Test water in the clear well for residual.

- If the chlorine is low, the Operator shall then switch over the sodium hypochlorite pump to the standby unit.

- Increase chlorination rate by 5 – 10% until level in clear well returns to acceptable levels. Reduce flow by the same amount.

- Repair or replace the failed unit.

- The secondary disinfection Chlorine Analyzer will signal the secondary disinfection system to add sodium hypochlorite if water from the pump is below the critical limit residual.

- The Secondary Disinfection System will alarm in the event of a duty pump failure. The operator shall switch to the standby pump to ensure ongoing secondary disinfection capability.

- Note, if the free chlorine residual at the end of the clearwell is not adequate to meet the CT requirements, the operator must immediately follow the reporting and corrective action requirements of Schedules 16 and 17 of O. Reg. 170/03.

8.5 Low Distribution System Residual Response Procedure

- Operator shall re-test. If results confirm low residual, follow next steps.

- Chlorine residual leaving plant shall be increased by 10%.

- Results to be recorded in log book. The Chief Operator shall be notified of situation.

- Operator to take action as instructed by the Chief Operator. Actions shall include:

    - Determining chlorine demand

- o Retesting at problem location
- o Testing at adjacent sampling sites
- o Flushing of mains
- o Etc.

- Note, if the free chlorine residual in any distribution system grab sample is below 0.05 mg/L, the operator must immediately follow the reporting and corrective action requirements of Schedules 16 and 17 of O. Reg. 170/03.

8.6 Low Pressure Response Procedure

If the pressure drops below 750kPa while the duty pump is running and the flow is remaining steady or increasing, the Operator shall:

- Immediately contact the Chief Operator

- Attempt to identify the location or source of the pressure drop and isolate the problem

- Continue to monitor pressure and flow.

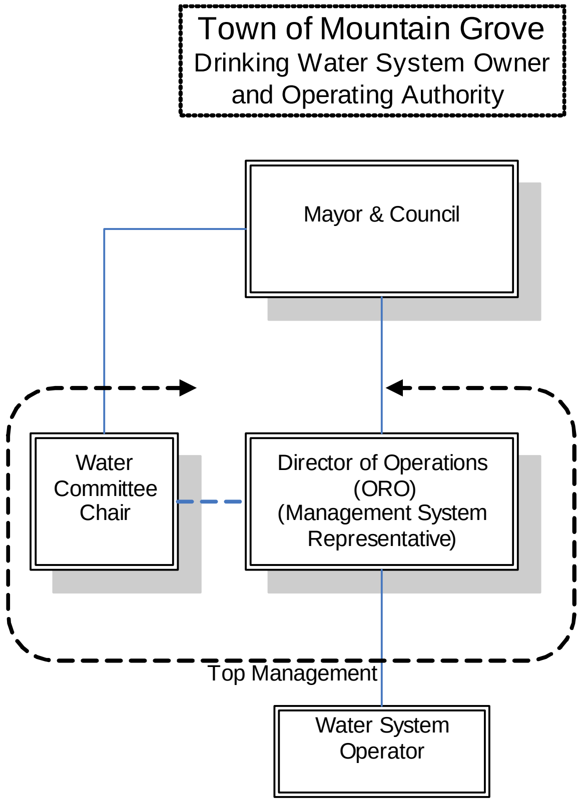
- If pressure drops below 650kPa, the SCADA system is programmed to shut down the duty pump.

- Note: if at any point the pressure in the distribution system drops to a point where the potential for backflow or backsiphonage exists, the operator shall immediately report the incident to the Medical Officer of Health and the Ministry of the Environment's Spills Action Centre.

If piping is in need of repair or replacement, it shall be super-chlorinated being returned to service as outlined in the disinfection of watermains procedure.

9. Human Resources

Town of Mountain Grove Water Quality Organizational Structure



10. Responsibility, Authority & Competencies

10.1 Mayor and Council

The Mayor and Council have the overall responsibility and authority to ensure that the Town of Mountain Grove waterworks meet all legislation and regulatory requirements. They further have the responsibility and authority to allocate the necessary resources for the safe operation of the works based upon the recommendations of the Water Committee Chair and the Chief Operator.

10.2 Water Committee Chair (Top Management)

The Water Committee Chair is a member of council and is responsible for the reporting of the performance of the waterworks to the Mayor and Council. The Water Committee Chair is authorized to make recommendations to the council concerning the works based upon the input of the Chief Operator and other interested parties.

10.3 Chief Operator (Top Management)

The Chief Operator, as the ORO, has the responsibility and authority to:

- direct the operations of the waterworks
- establish policies relating to the operation of the works and its employees and contractors
- provide input into the development of operating budgets
- make recommendations to the Superintendent, Clerk-Treasurer and council regarding water department operations
- communicate infrastructure and resource requirements to the Superintendent, the clerk-Treasurer and council.

The Chief Operator is also the QMS Representative. The QMS Representative shall be responsible for:

- ensuring that processes needed for the QMS are established, implemented and maintained
- reporting to the Water Committee Chair and Town Council on the performance of the QMS and any need for improvement
- ensuring that the most current versions of documents required by the QMS are being used at all times
- ensuring that personnel are aware of all current regulatory requirements that pertain to their duties within the operation of the drinking water system
- ensuring the promotion of awareness and effectiveness of the QMS throughout the operating authority.

Core Competencies: Post Secondary Education, 10 Years of municipal operations experience (water & wastewater), 5 Years Experience as Chief Operator, Current Class II WTP Operator certificate, Class I distribution Operator Certificate.

10.4 Part-time Water Systems Operator (2 positions)

The Water Systems Operator is responsible for monitoring and maintaining processed water quality, the maintenance of treatment and the maintenance of the distribution system including valves and hydrants and flushing. The Water Systems Operator shall

comply with all relevant legislation and regulations, and undertake activities at the request of the Chief Operator.

Core Competencies: Current Class I WTP Operator Certificate, Current Class I Distribution Operator Certificate, 2 Years as Water Treatment Operator , mechanical aptitude, ability proficiency with word processing and spreadsheet software, WHMIS training, SCADA Training, Training on the NAOCl disinfection, Basic Workplace Safety Orientation, drivers licence.

10.5 Satisfying Competencies

The Town of Mountain Grove may administer certain tests, conduct interviews, verify references and/or request specific documentation as part of the hiring process in order to verify skills, experience and knowledge.

In order to meet the ongoing changes to technology, software, the requirements of O. Reg. 128/04 and Water Department processes, the Chief Operator and the Water Systems Operators shall receive training as required by O. Reg. 128/04, as a minimum. The training may be provided on or off site by qualified employees or contracted subject matter experts. Training effectiveness is evaluated when appropriate through testing, or a demonstration of knowledge gained.

Training records are maintained by the Chief Operator.

11. Coverage

This procedure describes the coverage provided for the Town of Mountain Grove water works.

11.1 On-site Coverage

- The water treatment plant is staffed 5 days a week, 4 hours a day.

- All distribution system maintenance is contracted.

11.2 After-hours / Weekend / Stat Holiday Coverage

- The drinking water system is controlled and monitored by call. Any alarm condition is routed to a call centre that in turn contacts the overall responsible operator (ORO).

- The operator shall take the necessary action to investigate and address the alarm condition.

- The Chief Operator is the system ORO.

- A qualified system operator of the contract operating authority may at times be designated as the system ORO. Alternate ORO's are to be idenfieid in the logbook.

- The system ORO shall be available to respond within 2 hours of notification.

11.3 Emergency and Vacation Coverage

- The Chief Operator shall contract an outside operating authority to provide Emergency and Vacation Coverage for the Town of Mountain Grove water works, as needed.
- Contact information for contract operating authority services are included in the list of essential services.

- The contract shall be negotiated annually.

Note: The Town of Mountain Grove will hire a second qualified WTP Operator should the costs of contracting become prohibitive. The effectiveness of the method of coverage is evaluated during the annual Management Review.

12. Communications

This procedure describes how the Town of Mountain Grove communicates the QMS between Town Council and its employees, suppliers and the public.

12.1 Employees

- The QMS was initially rolled out to employees during two scheduled “lunch and learn” sessions sponsored by the Water Committee Chair. An overview of the QMS was presented by the Chief Operator.
- The Operational Plan was circulated to all employees with a Transmittal Sheet that required each employee to sign that they had read the Operational Plan.
- Procedures were also circulated with a Transmittal Sheet.
- Revisions to the QMS and associated procedures will be communicated to staff at meetings on an as-needed basis.

12.2 Suppliers

- All essential suppliers (for a list see the Purchasing Procedure) were provided with a handout describing the QMS as it relates to them.

12.3 Consumers

- The Town of Mountain Grove has included a billing insert that describes the QMS.
- The Quality Policy is posted in public areas of the Town Hall.

13. Essential Supplies and Services

This procedure identifies the supplies and services deemed essential to the delivery of safe drinking water and how to ensure the quality of essential supplies and services that can affect water quality.

All process chemicals must meet applicable AWWA and ANSI standards. Proof of chemical product must be provided to the operator upon delivery, prior to unloading. All testing conducted at laboratories must be conducted at laboratories that are accredited to conduct the tests.

The following products and services are deemed to be essential to the delivery of safe drinking water:

Essential Supplies and Services List		
Product / Service	**Primary Source**	**Secondary Source**
Sodium hypochlorite	Bretzlaff Pools & Spas 124 Boundary Road Mountain Grove, ON (613) 555 – 0011 Emergency: 555 - 0911	Clean Tech 2400 Overland Blvd. Ardoch, ON (613) 555 - 2022
Water testing	Bonnechere Laboratories 18 Main Street Eganville, ON (613) 555 – 7348 www.bonlabs.org/egan	Accurate Testing Services 44 Mullins Court Carleton Place, ON (613) 555 - 2114
Calibration	Metro Metrology 116 Hemlo Crescent Kanata, ON (613) 555 - 8909	Bob Harris Enterprises 6566A Concert Lane Ardoch, ON (613) 555 - 1219
Instrumentation parts	Sumter Sales & Service 150 Foxfield Drive, Unit 22 Ottawa, ON (613) 555-4959	Beaton Engineering 115 Deerwood Drive Ottawa, ON (613) 555 - 3125
Operations Emergency and Vacation coverage	Twp. Of North Williams Water Department Operations 24 Queen Street Marytown, On (613) 555-2839 After hours (613) 555-2223	
Contracting services	Oberlon Construction 4 Otterburn Street Mountain Grove, ON (613) 555 – 8219 After Hours: (613) 555 - 9110	Dashwood Contracting 137 Dale Road Mountain Grove, ON (613) 555 – 6643 After Hours: (613) 555 – 8646 ext. 12

- Each of these products or services is available from more than one source that is approved by the Water Department.
- With three treatment facilities, chemicals can be moved from one facility to another in the event of a shortage or an emergency.
- A minimum five day supply of chemicals is maintained at all times.

- Instrumentation parts kits, per the manufacturer's recommendations, are maintained at each facility.

The Chief Operator is responsible for the maintenance of chemical and instrumentation parts inventories.

All essential products and services are blanket orders covering the 12 month period from April 1st to March 31st.

For all other purchases, the Chief Operator shall forward a completed requisition form to the Water Department Manager for approval prior to the purchase of goods and services.

14. Review & Provision of Infrastructure

The Town of Mountain Grove maintains a rolling ten year infrastructure maintenance program.

In the third quarter of the fiscal year, the Chief Operator shall submit a program plan and cost estimate for any infrastructure work that is being proposed.

The program plan shall include the following:

Buildings, storage and distribution:

1. New infrastructure required in the upcoming year (due to regulation, growth or unforeseen circumstances).

2. Recommended infrastructure maintenance for the upcoming fiscal year and looking forward five years.

3. Recommended infrastructure rehabilitation or renewal for the upcoming year and looking forward for ten years.

4. Recommended infrastructure upgrading or replacement for the upcoming year and looking forward for ten years.

Machinery, equipment, software:

1. New machinery, equipment (includes tools and vehicles), computers, and software required in the upcoming year and looking forward for three years.

2. Planned and unplanned machinery and equipment maintenance and replacement parts for the upcoming fiscal year.

- Machinery and equipment planned maintenance costs (based upon the original manufacturer's recommended maintenance frequency)

- Machinery and equipment planned maintenance costs (based upon normal operating life and past planned and unplanned maintenance history)

The Program Plan shall be presented to the Chair of the Water Committee for comment, and then forwarded to council during budget deliberations. The Chief Operator and Water Systems Operator may be called upon to provide additional details.

Upon approval of the Program Plan, the Chief Operator shall begin the process of implementing the approved recommendations over the course of the fiscal year. The progress of the Plan shall be reported quarterly by the Chief Operator to the Water Committee Chair.

15. Infrastructure Maintenance, Rehabilitation & Renewal

15.1 Infrastructure Maintenance

Planned Maintenance: Buildings and distribution system

New construction or planned work to be done to existing structures shall be in conjunction/coordination with other operations departments whenever practical (i.e. sewer, power distribution, roads…). Other planned maintenance includes spring and fall hydrant flushing, and fall valve exercising / checking.

All new construction and work to existing structures shall comply with all relevant legislation and regulations. Typically, this work is subcontracted in accordance with Town of Mountain Grove policies and procedures. The Chief Operator shall ensure that contracted work is monitored as appropriate.

If the Planned maintenance can be conducted by the Town of Mountain Grove personnel then the Chief Operator shall issue a work order describing the work. Details of the work completed shall be recorded on the face of the work and returned to the Chief Operator for review and filing.

Unplanned maintenance: distribution system

Unplanned maintenance typically consists of main leaks/breaks, valve, hydrant and meter replacements. This work is contracted by the Chief Operator. A list of

acceptable contractors is contained within the purchasing procedure. All operational work must be conducted by a certified operator as required by O. Reg. 128/04.

Planned Maintenance: Machinery and equipment

Planned maintenance includes visual inspections, lubrication, fluid changes and other activities as recommended by the OE Manufacturer. Planned maintenance conducted by Water Systems Operator shall be scheduled and require a work order. A planned maintenance schedule is maintained by the Water Systems Operator. Details of the work shall be recorded on the face of the work order and forwarded to the Chief Operator for review and filing.

Unplanned Maintenance: Machinery and equipment – Water Treatment

The Water Systems Operator is responsible for the maintenance of the machinery and equipment associated with the pumphouse/treatment facility. The Water Treatment Operator has the authority to contract unplanned maintenance work to a qualified contractor (see Essential Products and Services List).

All unplanned maintenance work shall be recorded on a work order and forwarded to the Chief Operator.

Planned and unplanned maintenance: Computers, software, SCADA

The Town of Mountain Grove has an annual service contract for all maintenance of computers, software and the SCADA system. The appropriate personnel are notified prior to planned maintenance activities taking place. For unplanned maintenance please contact: CompuAid – (888) 555 - 3337 ext. #666.

The Maintenance, Rehabilitation and Renewal program will be reviewed by the Chief Operator who will monitor the effectiveness of these programs. A summary will be provided at the Management Review Meeting, after which the owner will be informed through copy of the meeting minutes.

16. Sampling, Testing & Monitoring

This procedure describes the sampling and monitoring activities for the Town of Mountain Grove water works. All sampling is in accordance with O. Reg 170/03. Additional sampling details are posted in the laboratory.

16.1 Sampling

On-site Sample Analysis

Sample Type	Source	Frequency
Free Cl2	Entry to clearwell	Grab Daily (also see table below)
Free Cl2	Discharge header	Grab 2 X Daily(also see table below)
pH	Intake	Weekly
Free Cl2	Discharge header	Grab Weekly (co-ordinated with Bacti)
Free Cl2	Distribution – 221b Baker Street	Grab Daily. (One grab taken with weekly Bacti)
Free Cl2	Distribution – 24 Austin Ave	Grab Weekly (co-ordinated with Bacti)
Turbidity	Well 1	Grab monthly
Turbidity	Well 2	Grab monthly

SCADA Continuous Sampling

Sample Type	Source	Device	Asset #
Free Cl2	Entry to clearwell	Pre Cl2 Analyzer	G2-A
Free Cl2	Discharge header	Post Cl2 Analyzer	G2-B

Accredited Lab

Sample Type	Source	Frequency
Bacti	Well 1	Weekly
Bacti	Well 2	Weekly
Bacti	Treated Water	Weekly
Bacti	Distribution – 221b Baker Street	Weekly
Bacti	Distribution – 24 Austin Ave	Weekly
Organics	Treated Water	Once every 36 months
Inorganics	Treated Water	Once every 36 months
Nitrate & Nitrite	Treated Water	Every 3 months
Lead	Distribution – 24 Austin Ave	Every 12 months
Sodium	Treated Water	Every 60 months
Fluoride	Treated Water	Every 60 months
Trihalomethanes	Distribution – 221b Baker Street	Every 3 months

- All sampling is in accordance with O. Reg 170/03.
- The date, time, location and results of all in-house samples taken are recorded on the corresponding Test Sheet.

- A summary of the sampling and testing results are summarized in the Annual Report. A copy of the Annual Report is provided to council during the next subsequent council meeting.

16.2 Monitoring

SCADA

The SCADA system is programmed to monitor process parameters and/or water characteristics in several locations – including raw water and treated water flow.

- Well levels, pumps, flow meters, analyzers, feed pumps, pressure and chlorine supplies (by tank levels) are all monitored by SCADA. Please refer to the SCADA manual for detailed information.

- The operator may adjust processes affecting water quality based upon the information and data provided by SCADA.

- Any adjustments made to process parameters shall be recorded in the Daily Log.

- Chlorine residuals are monitored at the entry to the clearwell and on the treated water.

- All parameters are trended by the SCADA system.

Visual

- The operator shall conduct a visual inspection ("rounds") of the treatment facility twice daily: upon start of shift and one hour before the end of shift.

- Results shall be recorded in the Daily Rounds log sheet.

- Equipment and building conditions, if deteriorating, shall be noted in the daily log and reported to the Chief Operator.

17. Measurement & Recording Equipment Calibration & Maintenance

17.1 Calibration

- On-line chlorine analyzers and the turbidimeter shall be calibrated at the frequency and using the method specified by the manufacturer. Results of these calibrations shall be recorded on the Instrument Calibration Sheet and retained at the WTP.

- The in-house lab analyzers shall be calibrated prior to each use.

- Flow meters shall be calibrated by a qualified subcontractor. Records of flow meter calibration shall be retained by the Operations Director.

18. Emergency Management

This procedure provides the steps taken to respond to a major emergency involving the water works.

A list of potential emergency situations and response plans is not included in this model emergency plan but can be found in the Emergency / Contingency Plan binder at the water treatment plant. Three general procedures are provided in this Operational Plan under sections 18.- through 18.3. Records of responses to emergencies shall be maintained the plant log book as required by O. Reg. 128/04.

All new staff will be required to review this operational plan and the Emergency / Contingency Plan binder. A sign off sheet will document that the transfer of information. Any changes to the emergency plans will be communicated to staff during meeting, as required. Meeting minutes will record the transfer of information. Once a year and prior to the Management Review, a desk-top exercise will be conducted to test selected procedures from the Emergency / Contingency Plan binder.

18.1 Unsafe Water In Well (Adverse Water Quality)

- Depending on type and degree of contamination (bacteriological, chemical), ensure MOH, MOE SAC, Chief Operator and Mayor are notified as necessary (see Emergency Contact List in section 18.4). Follow any instructions provided by MOH and MOE (boil water advisories, drinking water advisories, sampling, etc.).

- Shut down pump in affected well and continue operation with backup well.

- If boil water advisory or drinking water advisory is issued by MOH, inform public (Operations Director to contact local media, post notice on Town of Mountain Grove home page (website), and provide written notice door to door.

- Sample both water sources, treated water and three points in the distribution system for parameters of concern to assess degree of contamination to raw water, the drinking water treatment system and the distribution system.

- If required, increase chlorine dosage to ensure a minimum of 1.5 mg/l total or 0.5 mg/l free residual in the distribution system. Conduct flushing in the distribution system, if required.

- Re-sample and maintain operation on back-up well until two consecutive sets of samples are of acceptable quality, or as otherwise directed by the MOH and the MOE.

- Resume normal operation upon consent from MOH and MOE.

18.2

18.3 Unsafe Water In Distribution System (Adverse Water Quality)

- Depending on type and degree of contamination (bacteriological, chemical), ensure MOH, MOE SAC, Chief Operator and Mayor are notified as necessary (see Emergency Contact List in section 18.4). Follow any instructions provided by MOH and MOE (boil water advisories, drinking water advisories, sampling, etc.).

- Raise chlorine levels in the distribution system to a minimum of 1.5 mg/l total or 0.5 mg/l free residual chlorine.

- If boil water advisory or drinking water advisory is issued by MOH, inform public (Operations Director to contact local media, post notice on Town of Mountain Grove home page (website), and provide written notice door to door.

- Begin line flushing at affected site.

- Conduct appropriate sampling in the distribution system. Conduct sampling at both wells and of treated water if source is suspected to be raw water or treated water.

- If sampling results are not acceptable, search for leaks, potential backflow, etc.

- Continue to sample and test (and flush, if required) until two consecutive sets of samples are of acceptable quality, or as otherwise directed by the MOH and the MOE.

- Resume normal operation upon consent from MOH and MOE.

18.4 Power Failure

- Diesel gen-set automatically kicks-in on power failure.

- Operator or on-call operator shall contact local power authority to determine extent of failure and estimate of time gen-set will be running.

- Operator shall monitor gen-set performance during power failure.

18.5 Emergency Contact List

Contact	Contact Number(s)
Charlotte Whitton (Mayor)	Office: 555-1666 Home: 555 -1210
Bill Craigson (Chief Operator)	Office: 555-2400 Home: 555-1210
Bonnechere Labs	(613) 555-3748 After Hours (613) 555-6667
Dr. Shruti Prakash (MOH Eastern Ontario)	(613) 555-9111 Cell: (613) 555-7002 Fax: (613) 555-9820 24 Hr. Emergency Line: (877) 555-1999
MOE	Spills Action Centre: 1-800-268-6060 Frank: (613) 555-2328 Ottawa: Main Office: (888) 555-7622

See also Essential Supplies and Services List

19. Internal Audit

Internal audits are conducted to ensure that the QMS conforms to the requirements of the Town of Mountain Grove Operational Plan and the DWQMS. These requirements include ensuring that the QMS has been effectively implemented and properly maintained.

The Town of Mountain Grove may, from time-to-time, request that internal audits be conducted by trained auditors from a neighbouring municipality. In turn, the Town of Mountain Grove may provide the same to other municipalities as the case arises.

19.1 Audits Conducted by Town of Mountain Grove

Auditors

- All internal auditors must have successfully completed a recognised 16 hour Internal Auditor workshop

Internal Audit Schedule

- Internal audits are scheduled throughout the year. The audits are scheduled by Element by month. The assigned auditor's name also appears on the schedule.
- The audit schedule is developed and published at the end of February each year for the upcoming fiscal year by the Chief Operator. There are no audits scheduled for July, August or March.
- Each element of the Standard is audited at least once during the fiscal year.

Audit Planning

- The auditor shall review all related QMS documentation and the results from the last internal and external audits prior to the audit. The auditor shall develop or obtain an audit checklist at least one week prior to the audit, which includes all of the requirements of the DWQMS.

Conducting the Audit

- The auditor shall observe activities, review records and interview personnel as necessary to ensure that the status of the audited element of the QMS has been effectively covered.

Reporting the Results

- The auditor shall submit a completed checklist and report to the Chief Operator.

- The report shall include any requirement for corrective actions to address gaps between the DWQMS and how the QMS is written and implemented. Corrective actions shall be communicated to the responsible individual and included as part of Management Review input.

19.2 Audits Conducted by Another Municipality

Auditors

- Outside auditors must provide proof of competency prior to conducting an audit.

Audit Schedule

- Audits are to be conducted per the Town of Mountain Grove schedule.

Planning and Conducting the Audit and Reporting the Results

- Audits may be planned and conducted per the procedures of the auditing Municipality. Prior approval by the Chief Operator is required.

- Audit results may be reported per the procedures of the auditing municipality as long as the results are documented. Requirements for corrective action must be indicated.

20. Management Review

This procedure defines the Management Review process to ensure the continuing suitability, adequacy and effectiveness of the QMS.

20.1 Review Frequency

- Management Reviews shall be conducted on an annual basis prior to completion of the annual budget process.

20.2 Review Participants

- The management review is convened by the Water Committee Chair. Attendees shall include the Chief Operator and the water system operator. Invitees may include council members.

20.3 Review Input

- The Chief Operator shall provide information and data concerning the following categories, for the review:

  - incidents of regulatory non-compliance
  - incidents of adverse drinking water tests
  - deviations from identified critical control limits and actions taken
  - the efficacy of the risk assessment process
  - results of internal and 3rd party audits
  - results of relevant emergency response testing
  - operational performance and water quality trends
  - follow-up on actions items from previous management reviews
  - effectiveness of contracted coverage
  - status of action items (if any) identified between management reviews
  - changes in resource requirements, infrastructure, process, personnel, Drinking Water Quality Management Standard or regulations that could affect the QMS
  - consumer feedback
  - any resources needed to maintain the QMS
  - the results of the infrastructure review
  - a summary of the effectiveness of the Maintenance, Rehabilitation and Renewal program
  - Operational Plan currency, content and updates
  - staff suggestions

20.4 Review Process

- The Management Review shall be a planned event. A minimum of four hours shall be set aside by the participants to ensure a thorough review of the QMS is conducted.

- Each input category shall be reviewed in order to identify if, where and when improvements to the QMS and its procedures are required.

- The Chief Operator shall make note of any changes or action items required during the course of the review.

20.5 Review Output

- A list of changes required to be made to procedures or other QMS based documentation.

- A list of “action” items. All action items shall identify an individual responsible and a timeline to implement the action item.

- Recommendation(s) for any human or financial resources needed for maintenance of improvement of the QMS.

- Minutes of management review shall be maintained by the Chief Operator. These minutes shall include the date and time of the review activity and the name of participants and attendees. The minutes will be provided to council during the next council meeting.

Model Operational Plan - D

Description

A surface water supply system with a treatment plant and distribution network.

Ownership

The system is owned by the municipality.

Operating Authority

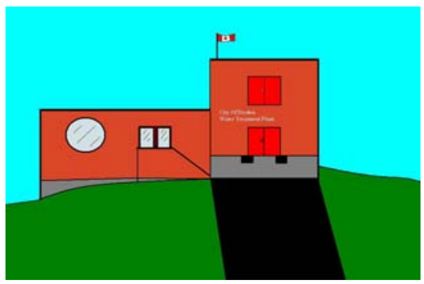
The operating authority is the municipality.

Note: **Some procedures referenced in the following operational plan may not be included.**

City of Dalkeith

Drinking Water Quality Management System

Operational Plan



City of Dalkeith Water Supply System
120 Water St
Dalkeith, ON

The Operational Plan for the City of Dalkeith Water Supply System will become effective on the 1st day of January, 2007

Table of Revisions

Date	Description of Revision

Table of Contents

1. Quality Management System

The City of Dalkeith Drinking Water Quality Management System (QMS) is documented in this Operational Plan as part of our efforts to ensure that clean, safe and reliable drinking water is supplied to all customers served by the City of Dalkeith Water System. The development and continual improvement of the plan will help ensure that all regulatory requirements are met and that consumers can be confident that their drinking water will be protected through the effective application of the QMS.

This plan was developed to meet the Ministry of the Environment's Drinking Water Quality Management Standard (the Standard).

2. Quality Management System Policy

The City of Dalkeith is committed to managing the treatment and supply of clean, safe drinking water to all of its customers and commits to consistently meeting all applicable legislative and regulatory requirements, and customer needs.

To achieve these goals the City of Dalkeith commits to:

- Managing water quality from source to customer
- Regular monitoring and testing of water to meet or exceed current regulatory requirements
- Providing consistent and relevant training to operators to meet or exceed current training requirements
- Investing capital monies to provide upgrades and rehabilitations to treatment and distribution systems
- Continuing to establish and upgrade current practices and policies
- Participating in meetings and pilot projects to remain on the leading technical edge of drinking water supply
- Providing Water Treatment Plant Annual Reports, as per Ministry of the Environment requirements, to be available to all customers in hard copy and on the City web site.

These reports provide the customer with an annual overview of the City water supply system.

The City of Dalkeith will establish and maintain a Drinking Water Quality Management System (QMS) that will be regularly reviewed, improved and upgraded by management and employees involved in the supply of drinking water. The highlights of this Operational Plan for this Quality Management System will be readily available in hard copy at the Public Works offices or it can be accessed on the City of Dalkeith website (www.Dalkeith.ca).

The Drinking Water Quality Management System will be implemented by the City to effectively minimize and manage any potential risks to drinking water quality and safety.

3. Commitments and Endorsement

This Operational Plan as been reviewed and approved by City of Dalkeith Senior Management, Middle Management, and Senior Operational Staff. This is a blueprint for the planning, operation, and maintenance of the City of Dalkeith Water Supply System. An annual review by the Council / Mayor (owner), the City Manager (Top Management), Director of Engineering and Public Works (Top Management), Manager of Infrastructure and Works, and the Chief Plant Operator will keep the document up to date and promote continual improvement. All recommended changes would be approved by Council resolution.

Endorsed by:

Mayor (Owner)

Chief Plant Operator

City Manager (Top Management)

Manager, Infrastructure and Works

Director of Engineering and Public Works (Top Management)

4. Designated QMS Representatives

The City of Dalkeith has designated two individuals who equally share the duties as QMS Representatives.

Name: Roy Williams
Position: Manager, Infrastructure and Works

Name: Bob James
Position: Chief Operator / Overall Responsible Operator (ORO)

The QMS Representative will be responsible for the following:

- Ensuring that processes and procedures needed for the QMS are established and maintained
- Reporting to Top Management on the performance of the QMS and any need for improvement, as needed, or during the Management Review meetings at a minimum
- QMS document and record control
- That through training, personnel are made aware of all applicable legislative and regulatory requirements that pertain to their duties for the operation of the subject system
- Promoting awareness of the QMS throughout the water department of Public Works

5. Documents and Records Control

A procedure is in place for Document and Record Control. This procedure describes how documents and records are controlled and is attached as Appendix A at the end of this document.

6. Drinking Water System

The Dalkeith Water System is owned and operated by The Corporation of The City of Dalkeith and serves the urban citizens of Dalkeith.

6.1 Source Water

The raw water source for the City of Dalkeith is Rock Lake, which is part of the Rock Valley chain of lakes. There are roughly seven lakes and rivers in the system, which is approximately 50 kms in length. Around 5 kms downstream of the intake for the Dalkeith WTP, there is a dam located on the Rock River at the pulp and paper mill. This dam regulates and controls the depth of the lake, which makes it a very reliable source. The lake has a clay base and is relatively shallow. The maximum depth is reported to be approximately 14.8 metres. The average depth is between 3.7 – 5.5 metres. Raw water quality can be characterized as having high levels of turbidity (0.12 – 33 NTU), aluminum (0.14 - 0.62 mg/l) and colour (9 – 132 tcu). These results were taken over a five-year period, from 2000 through the end of 2005. The temperature fluctuates between 1˚ Celsius in the winter months, to 25˚ Celsius in the summer months. Generally, because of the clay and silt in the water, floc formation is usually quite rapid and easy to accomplish with alum.

In 2004 and 2005, the concentration of E.Coli ranged from zero in the winter months to 9 cfu/100 mL in the summer months, while the concentration of total coliforms ranged from zero in the winter months to up to 98 cfu/100 mL in the summer months.

6.2 Events

Due to the shallow depth of the lake, vertical turnover in the spring and fall usually goes unnoticed. However, depending on the severity and direction of the wind, a slight rise in the raw water temperature and an increase in the solids loading on the treatment units has been noted on a couple of occasions. Usually it only lasts for a day or two and can be corrected by making the appropriate physical or chemical adjustments to the treatment process, which is the same response for algae blooms and high south winds in the summer months. **Refer to Section VII, page 2, in the WTP Operations Manual for Reference.**

Additionally, because of the cold water temperatures in the winter months, some minor chemical adjustments must be made in the process.

6.3 Threats

Potential sources of raw water contamination include spills from the highway or railway, and high rainfall causing pesticide runoff and septic system surcharge from the Golf and Curling Club. Since there is only a single intake line for the WTP, there is also the risk of a collapsed or plugged intake line. The pump house is located on a secluded, unpopulated area of the golf course, close to a public beach, so the potential for vandalism or damage by fire is a concern.

6.4 Operational Challenges

Rock Lake provides a good, consistent supply of source water. The most significant challenge related to the source water is more of a quantity issue rather than quality issue. The absence of a second intake and supply line leaves us somewhat vulnerable to a loss of source water due to pipe blockage or failure.

6.5 Treatment System

Raw water is presently drawn from Rock Lake, through a 450 mm diameter, schedule 80 polyethylene pipe. It extends approximately 250 metres into the lake and supplies raw water via gravity, to the Low Lift pumping station. The water passes through two screens (one course & one fine), before entering the station.

The Low Lift pumping station houses three 60 hp vertical turbine pumps (2 – duty & 1 – back-up), each with a capacity of 80 L/s. There is also a 100 hp diesel emergency pump with a capacity of 80 L/s.

The raw water is pumped from the Low Lift to the WTP through approximately 3 kms of 400 mm diameter, class 150 asbestos-cement pipes.

6.6 Treatment (coagulation, flocculation, sedimentation)

Raw water enters the WTP through a 400 mm steel pipe, which is reduced to 300mm after a short distance. Alum is added at this time for coagulation. The water then passes through a 250 mm Venturi meter for flow measurement. Downstream of the Venturi, the flow is then equally distributed to two Infilco Solids Contact Units (SCUs). As water enters the lower part of the

central hood, a polymer is added to add weight and strengthen the floc. The mixture of water and floc is lifted up through the central hood by a variable speed impellor and is then discharged into the main mixing chamber where reactions are brought to completion. Some water and suspended particulate enter the lower end of the central hood for recirculation and contact with incoming raw water. New floc formation is encouraged by contact with these previously formed flocculates. The rest of the water enters the outer settling section. The lighter floc is kept suspended and clarified water rises to the outlet flume above. The heavier floc settles and is carried along the bottom by a rotating scraper to sludge pits, where it is drained off through automatic blowdown valves into the sanitary sewer. Before the clarified water leaves the unit, it is mixed with hydrated lime to bring the pH back up to the desired level.

6.7 Filtration

The clarified water now travels to one of the four "dual media" rapid sand filters. As the water passes down through the anthracite and fine sand particles (0.45 mm - 0.55 mm), any light floc or carryover from the SCUs will be removed, leaving crystal clear, colorless water with turbidity around the 0.040 - 0.070 NTU range. Each filter is equipped with a turbidity meter and a filter-to-waste valve to allow the filter to ripen before returning it back to service. The filtered water flows to a 586 ML clearwell, and then to a 6,535 ML underground storage reservoir, which provides approximately 18 hrs of supply.

In the event that the turbidity of the filtered water rises above a desired level (set at 0.5 NTU), a high turbidity alarm will signal and the filter-to-waste valve will open, draining the filter to the waste line instead of the clearwell, minimizing chance of contamination.

6.8 Chlorination / Disinfection

Chlorine gas is used for primary disinfection. It is added to the treated water after the clearwell and before the reservoir to ensure that any potentially harmful organisms are destroyed prior to distribution to consumers.

Secondary disinfection is accomplished by adding sufficient chlorine at the WTP to maintain an adequate residual throughout the entire distribution system.

6.9 Process Waste Management

Filter backwash and process wastewater enters two clarifier-settling basins. The wastewater is allowed to settle for a predetermined set time and is decanted to the receiving stream, Sand Lake. The heavier settled solids are pumped to the sanitary sewer.

6.10 Distribution System

Treated water flows from the reservoir to the pumpwell. The pumpwell is equipped with 3 – 50 hp vertical turbine pumps, each with a capacity of 68L/s. The pumping strategy consists of one variable speed drive pump continuously running to provide a system pressure of 42 – 45 psi in the distribution system at the WTP. A constant speed pump activates when the variable speed pump cannot sustain the target pressure. A third pump provides redundant capacity, and there is also a diesel driven emergency pump on standby.

Prior to the water leaving the plant, the free chlorine residual and turbidity levels are measured through on-line analyzers.

The distribution network consists of approximately 60 km of piping and consists of 40 km of cast iron, 16 km of ductile cast iron, 1 km of PVC, 0.1 km of HDPE and 2 km of smaller diameter copper. The sizes range from 150 mm to 250 mm for distribution mains, 300 mm and 400 mm feeder mains, and copper mains of 25 mm to 50 mm diameter. Within the system there are 407 valves and 272 fire hydrants. Most fire hydrants have isolation valves. The distribution system also provides potable water to the pulp and paper mill. The mill has its own fire protection system. There are no elevated storage tanks or booster stations in the system.

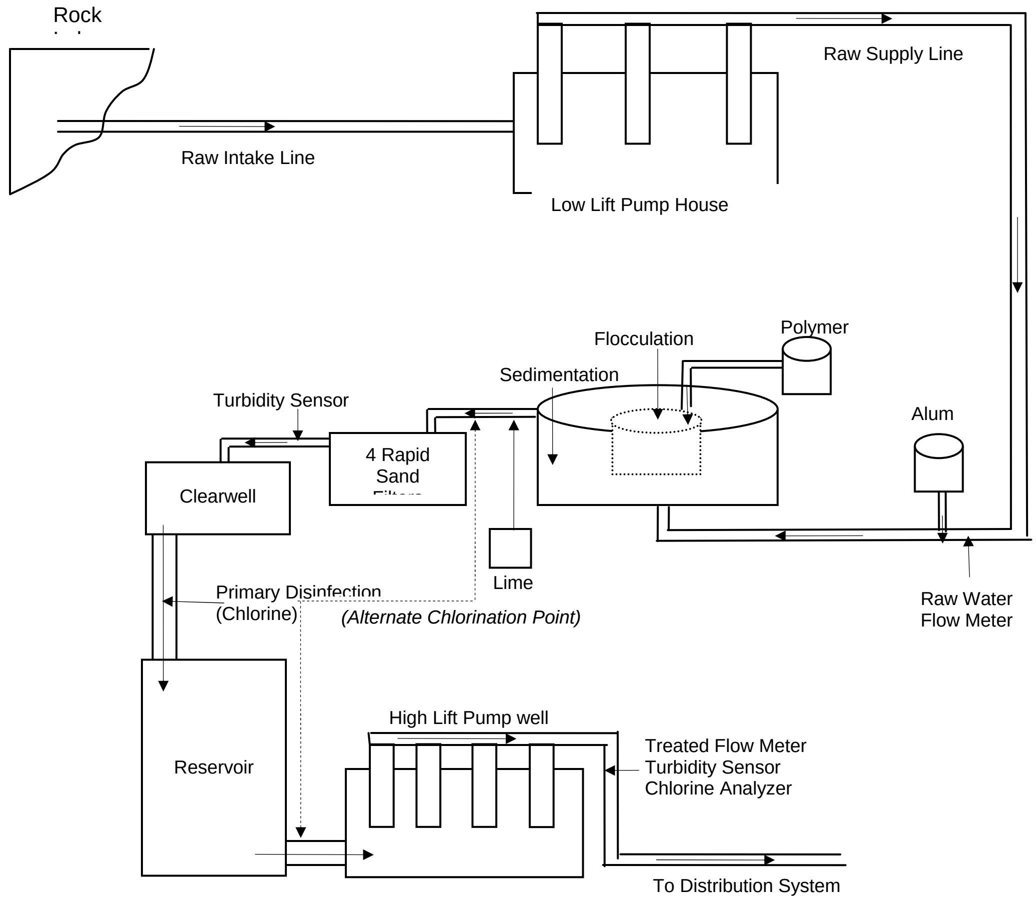
6.11 Barriers to Microbiological Pathogens

The following processes remove potentially pathogenic organisms:

1. Coagulation / Flocculation / Sedimentation
2. Filtration
3. Chlorination (primary disinfection)
4. Distribution system chlorine residual (secondary disinfection)

6.12 Analyses

Ontario Regulation 170/03 and the current Certificate of Approval issued by the Ministry of Environment (MOE) dictate the sampling and monitoring requirements for this system. Water quality is tested throughout the treatment process and from dedicated locations throughout the distribution system.



7. Risk Assessment (covered under Section 8)

8. Risk Assessment Outcomes

The City of Dalkeith has established, implemented and maintains this procedure to determine what potential hazards and critical control points exist in the Water Treatment and Distribution System.

The Risk Assessment Team consists of the Manager of Infrastructure and Works and the Chief Plant Operator (ORO) and could also include operations staff, as required.

The Risk Assessment Procedure is conducted annually, prior to the QMS Management Review, or more frequently if a significant process change or upgrade has occurred.

The process for hazard analysis includes an assessment of each process step and/or activity associated with the Water Treatment and Distribution System, and identification of hazards that are potentially present or possible at each process step and/or activity.

Once hazards are identified, the next step is the determination of critical control points (CCPs).

This process involved a risk assessment by prioritizing hazards and identifying points where control may be exerted to eliminate or minimize those hazards.

The risk assessment was performed by rating the likelihood, severity and detectability of each hazard at each relevant process step or activity on a scale of 1 to 5. The values for each of these factors were added together to give a risk priority number. Based on a review of the overall risk values and the associated events, a threshold number was chosen such that all events associated with risk values which were equivalent to or greater than the threshold number were considered critical. Those points where control could be exerted over the hazards which had risk values equivalent to or greater than the threshold number, were considered critical control points.

Likelihood is probability/likelihood of a hazard or hazardous event occurring.

Severity or Consequence is the potential impact to health or impact on operations if the risk is not controlled (assumes control measures do not work).

Detectability is a measure of the ability to detect the presence of certain hazards. Hazards which could be easily and quickly detected were given a low value. Hazards that are hard to detect or undetectable were given a high value. The risk becomes greater as appropriate responses cannot be taken to control or mitigate the risk.

The rating system is defined on the following page:

Description	Likelihood of Hazard Occurring	Rating
Rare	May occur in exceptional circumstances, or has not occurred	1
Unlikely	Could occur at some time, historically has occurred annually or less than annually.	2
Possible	Has occurred once or more per year.	3
Likely	Has occurred on a monthly to quarterly basis.	4
Very Likely	One or more occurrences on a monthly or more frequent basis	5

Description	Severity of Hazard Occurring	Rating
Insignificant	Insignificant impact, little disruption to normal operation.	1
Minor	Minor impact for small population, some manageable operation disruption, some increase in operational requirements.	2
Moderate	Minor impact for small population, significant modification to normal operation but manageable. Increased monitoring and operational requirements.	3
Major	Major impact for small population, systems significantly compromised and abnormal operation if at all.	4
Catastrophic	Major impact for large population, complete failure of all systems.	5

Description	Detectability of Hazard	Rating
Very Detectible	Very easy to detect, instantaneous, SCADA monitored	1
Moderately Detectable	Moderately detectable, alarm present but not in SCADA, may require operator to walk by and notice alarm; problem is indicated promptly by lab test results.	2
Normally Detectable	No alarm present, visually detectable on rounds or regular maintenance.	3
Poorly Detectable	Poorly detectable, visually detectable but not inspected on a regular basis; would not be detected before a problem was evident; lab tests that are not done on a regular basis.	4
Undetectable	Undetectable, cannot detect.	5

Included in the following pages is a chart that identifies the process and activity hazards related to the Water Treatment and Distribution System that were identified, along with the outcome of the risk assessment, and the identification of which of these were identified as critical control points.

Critical control points identified in the table that follows have controlled conditions that are established, implemented and maintained that include:

a) Critical limits
b) The availability of information to operations personnel that outlines the critical limits and how to monitor the limits

c) The availability and awareness of standard operating procedures (SOPs), which include recovery and reporting / recording procedures, as necessary, and
d) The reliability and redundancy of equipment, as appropriate to the identified risks and nature of the Water Treatment Plant.

In responding to these hazards / hazardous events, all details should be recorded in the plant and/or distribution system log book per O. Reg. 128/04.

Element or Process Step	Description of Hazard	Potential Result of Hazard	Comments	Available Monitoring & Control Measures	Emergency Procedure or Contingency Plan	Likelihood	Severity	Detectability	Risk Priority Number	CCP?	Control Procedure
Source water	Rail Car Derailment or Highway Accident - spill of chemical or contaminant	Chemical contamination of source water		Notification to MOE Spill Action Centre (SAC) of spill and potential for contamination of source water	Shut down intake. Stop producing water until plume passes. Obtain water supply from storage, implement water restrictions if necessary, haul water if necessary. Conduct sampling on raw / process / treated water if necessary.	1	1	1	3	No	
	Proximity of septic system at Golf & Curling Club to Lake in vicinity of intake. - discharge of inadequately treated septic system effluent as a result of flooding, high rainfall, etc.	Biological contamination of source water	An upstream process to be captured under Source Water Protection.	Conventional water treatment operations to treat source water. Weekly bacteriological testing of raw and treated water. Continuous testing for chlorine and filtered water turbidity.	Discuss with Ministry of Health re: source of e.coli	2	2	2	6	No	
	Proximity of Golf & Curling Club to Lake in vicinity of intake - pesticides in runoff water as a result of flooding, high rainfall, etc.	Chemical contamination of source water	An upstream process to be captured under Source Water Protection.	Interim Measure: Annual correspondence letter re: risks associated with pesticide application and runoff. Treated water testing for pesticides in use at Club conducted in summer months.	**Future action** Discuss with owner of golf course	1	1	2	4	No	

Element or Process Step	Description of Hazard	Potential Result of Hazard	Comments	Available Monitoring & Control Measures	Emergency Procedure or Contingency Plan	Likelihood	Severity	Detectability	Risk Priority Number	CCP?	Control Procedure
	Collapse or breakage of single intake pipe	Quantity / Quality		Pump shut down on low level alarm in pump well; Loss of raw water flow signal	Switch to alternate temporary pump and line to low lift pump house; obtain water supply from storage and notify community through local radio regarding water restriction. Haul water, if necessary.	1	4	1	6	No	
	Fire at low lift pumping station– loss of controls and pumps	Quantity / Quality	Potential for security issues / vandalism. Emergency Situation.	Loss of SCADA signal from low lift pumping station Loss of raw water flow – flow meter	**Future action**: separate low lift operations from golf course operations.	1	5	1	7	No	
	Single pipe – low lift pump station to plant - breakage	Quantity / Quality		Loss of raw water flow signal	Dig and Repair Pipe; Pipe & fittings in stock.	1	3	1	5	No	
Treatment	Loss of coagulant – plugging of lines, pump failure, clogging of screens	Biological & chemical contamination	Crypto / Giardia not removed without coagulant.	On-line chemical flow monitor triggers auto switch-over to back up chemical pump. "Auto" Filter to Waste Valves. Critical Control Limit for filter effluent turbidity = 0.5 NTU.	See recovery procedures in Operations Manual (OM). Note: If coagulant not applied or if turbidity of filter effluent exceeds 1.0 NTU for 15 minutes or more, report to Medical Officer of Health (MOH) and Ministry of Environment SAC per O. Reg. 170/03.	3	3	1	7	Yes	OM: S. 7 'Operating Problems & Solutions', pg 1 'Alum Feed'
	Loss of polymer– plugging of lines, pump failure, clogging of screens	Shorter filter runs		High level alarm at filter; Visual inspections throughout the day	Repair polymer feed system. Note: If turbidity of filter effluent exceeds 1.0 NTU for 15 minutes or more, report to MOH and Ministry of Environment SAC per O. Reg. 170/03.	3	1	2	6	No	

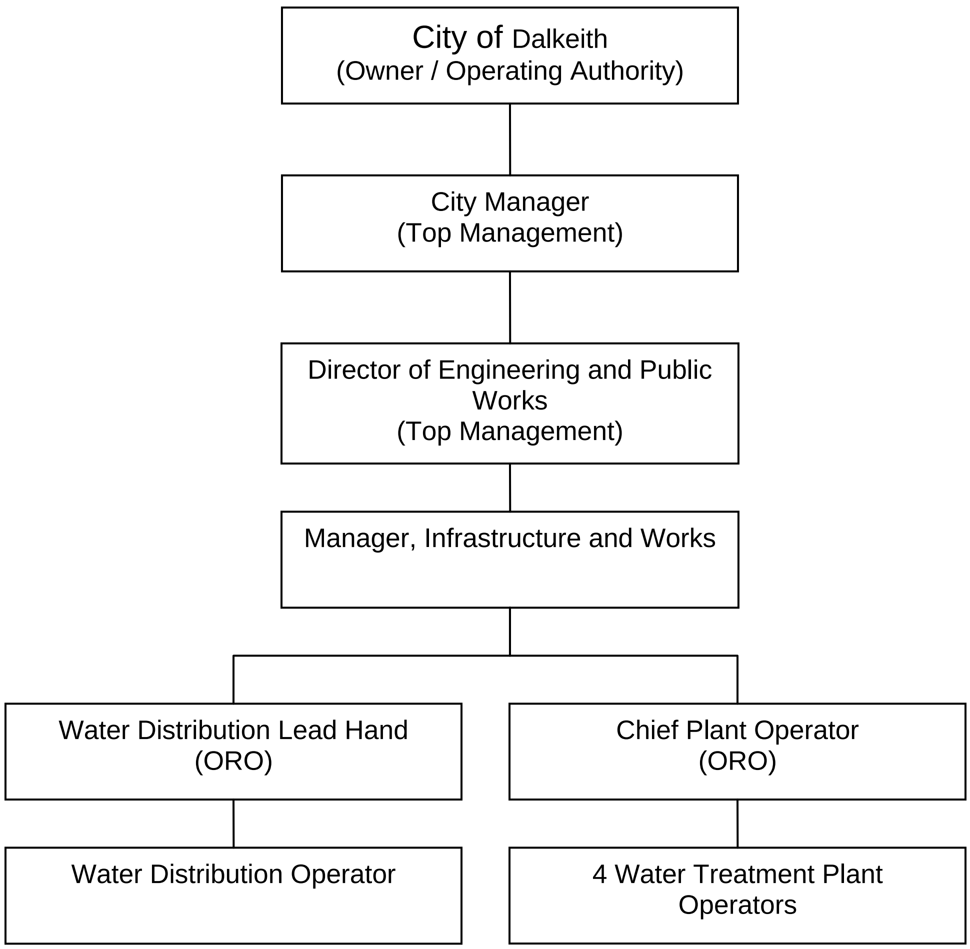
Element or Process Step	Description of Hazard	Potential Result of Hazard	Comments	Available Monitoring & Control Measures	Emergency Procedure or Contingency Plan	Likelihood	Severity	Detectability	Risk Priority Number	CCP?	Control Procedure
	Flocculator failure	Shorter filter runs		High level alarm at filter; Visual inspections throughout the day	Repair flocculator drive system. (Impeller drive). Spare parts on-site. Note: If turbidity of filter effluent exceeds 1.0 NTU for 15 minutes or more, report to MOH and Ministry of Environment SAC per O. Reg. 170/03.	2	1	2	5	No	
	Filter breakthrough, filter underdrain failure	Biological contamination	Crypto / Giardia not removed without coagulant.	On-line filter effluent turbidity meters. Critical Control Limit for filter effluent turbidity = 0.5 NTU. “Auto” filter to waste valves.	Shut down filter; take it out of service. See recovery procedures in OM. Note: If filter breaks through or if turbidity of filter effluent exceeds 1.0 NTU for 15 minutes or more, report to Medical Officer of Health (MOH) and Ministry of Environment Spills Action Centre (SAC) per O. Reg. 170/03.	2	4	1	7	Yes	OM: S. 7, ‘Operating Problems & Solutions’ pg. 5 ‘Filters’
	Backwash pump failure (only 1 pump)	Quantity / Quality		Shut down of filters on high turbidity, alarms	Spare parts for pump at WTP. See procedures in OM.	1	2	1	4	No	
	Filter to waste valve failure	Biological contamination		Shut down of filters on high turbidity, alarms.	Shut down filter; take it out of service. See procedures in OM.	2	2	2	6	No	

Element or Process Step	Description of Hazard	Potential Result of Hazard	Comments	Available Monitoring & Control Measures	Emergency Procedure or Contingency Plan	Likelihood	Severity	Detectability	Risk Priority Number	CCP?	Control Procedure
Primary Disinfection	Chlorinator failure	Biological contamination	Bacteria and viruses not inactivated without chlorine.	Failure alarm on chlorinator shuts down raw water pumps. Online chlorine analyzer alarm Critical Control Limit = 0.75 mg/L	Automatic switchover to standby chlorinator & spare parts to make repairs. Note: If CT requirements not met, report to MOH and Ministry of Environment SAC per O. Reg. 170/03. Recovery procedures per OM and O. Reg. 170/03.	1	5	2	8	Yes	OM: S. 7 "Operating Problems & Solutions" pg. 7. "Low Chlorine Residual"
Reservoir	Loss of structural integrity of reservoir – leakage into reservoir	Biological contamination Chemical contamination		On-line turbidity meter& chlorine analyzer, weekly bacteriological testing. Daily treated water colour analysis. Site fenced / locked.	See procedure in Contingency Plan binder. Notify MOH and Ministry of Environment SAC. Shut down & by-pass to Pumpwell. Drain and repair as required. Clean and disinfect reservoir per AWWA procedures. Switch to alternate chlorine injection point, increase dosage and issue water restriction notice to community. (Long-term plan to construct additional reservoir to allow inspection)	1	3	2	6	No	
Distribution	Breakage of single pipe from plant to distribution system	Quantity / Quality	No distribution system storage; need to pump continuously from the plant.	Community complaints; Low pressure alarm or high flow indicators at the plant.	See procedure in Contingency Plan binder. If system pressure compromised Report to MOH and Ministry of Environment SAC. Repair and flush distribution system. Increase chlorine and conduct sampling in distribution system. (Long-term plan to twin)	1	5	1	7	Yes	See: "Emergency Procedure for Watermain Breaks" at PW Office.

Element or Process Step	Description of Hazard	Potential Result of Hazard	Comments	Available Monitoring & Control Measures	Emergency Procedure or Contingency Plan	Likelihood	Severity	Detectability	Risk Priority Number	CCP?	Control Procedure
	Loss of chlorine residual (secondary disinfection)	Biological contamination	Legislated under O. Reg. 170/03.	Daily residual testing at far end of system, weekly monitoring at locations in town	Report to MOH and Ministry of Environment SAC as required by O. Reg. 170/03. Flush the system; increase chlorine dosage and resample.	2	3	3	8	Yes	See O. Reg. 170/03 requirements for corrective actions.
	Loss of pressure – watermain break, major fire	Biological and chemical contamination		Customer complaints, low/high pressure alarms at plant	If system pressure is compromised, and potential for backflow exists, report to MOH and Ministry of Environment SAC. Follow; Procedure for Watermain Break Repair in OM.	4	2	3	9	Yes	Disinfection procedures for new construction and repair. Follow Procedure for Watermain Break Repair in OM.
	Cross connection	Biological and chemical contamination	Backflow preventers.	Visual	If backflow suspected, report to MOH and Ministry of Environment SAC. Isolate area. Flush the system and sample as needed. Repressurize system.	4	2	3	9	Yes	Future by-law to require backflow preventers.
	High lift pump failure	Quantity / Quality		Low pressure	Back-up pumps	3	1	1	5	No	
	Failure of SCADA	Quantity / Quality		Loss of raw flow and signal.	Run on Manual	2	3	1	6	No	

9. Organizational Structure, Roles, Responsibilities, and Authorities

9.1 Organization Chart



9.2 City of Dalkeith, Mayor and Municipal Council (Owner)

The City of Dalkeith, which is represented by an elected Mayor and municipal council, is responsible for ensuring the delivery of a safe and reliable supply of drinking water to the residents of the City of Dalkeith.

The owner has the authority to delegate the management of the drinking water system to qualified staff.

9.3 City Manager (Top Management)

The City Manager is responsible for arranging reports to the mayor and council on the oversight of the municipal water system. The manager will receive (information) reports from the Director of Engineering and Public Works regarding issues that are relevant to the overall operation of the water system.

The City manager is authorized by council to ensure that management staff is in place to ensure the municipal water system is supplying safe and reliable drinking water.

9.4 Director of Engineering and Public Works (Top Management)

The Director is responsible for ensuring that operations within the municipal water supply system are being performed to ensure that municipal drinking water is safe and systems are in compliance with current regulations. The Director must provide long term planning and budgeting, inform the City Manager and Council of deficiencies and required resources and provide the City Manager and Council with current technical and administrative information and advice.

The Director has the authority to ensure staff is in place to manage the water supply system, develop administrative and technical policy, evaluate and prioritize long term utility needs.

9.5 Manager, Infrastructure and Works (QMS Representative)

The Manager, Infrastructure and Works is one of the two QMS Representatives and is also responsible for the management of the daily operations of the water treatment plant and distribution system. The manager will provide guidance to and receive feedback from operators on regular operations and future needs. Responsibilities also include preparing reports for capital expenditures, budgeting, maintenance activities, and infrastructure condition assessments for the Director, council, regulatory authorities and public.

The manager is authorized to direct operators, develop policies, and communicate with regulatory and technical authorities including the Director of Engineering, senior managers and the general public.

9.6 Chief Plant Operator (ORO and QMS Representative)

The Chief Plant Operator is the second QMS Representative and is designated as the Overall Responsible Operator (ORO) for the Water Treatment Plant. As the ORO, the Chief Plant Operator is responsible for the supervision of daily operations and staff at the Water Treatment Plant. The Chief Operator ensures that all operations are in compliance with current regulations. Responsibilities include oversight of process operation and controls, scheduling maintenance, scheduling staff, ensuring that employees' certifications and minimum training requirements are up to date, confirming all required tests are completed, reporting normal and abnormal conditions to the Manager. The Chief Operator also ensures that standard operational procedures are followed as documented on the Operations Manual. The Chief Plant Operator must maintain a minimum Class II Water Treatment certificate to fulfill the required responsibilities.

The Chief Operator is authorized to make any process adjustments to ensure the supply of safe and adequate drinking water. Authorization includes purchasing of process chemicals, lab supplies, testing services, and equipment parts. The Chief Operator is also authorized to direct the duties of the plant operators and supervise any on site contractors.

9.7 Water Distribution System Lead Hand (ORO)

The lead hand is the designated Overall Responsible Operator (ORO) for the distribution system, and is responsible for the supervision of daily operations and maintenance of the water distribution system. This includes ensuring a safe and adequate supply of water for all customers. The lead hand directs operators and contractors in the repair and maintenance of all aspects of the distribution system, which includes hydrants, main valves, services and shut offs. Recording of daily activities, following current regulations and reporting of normal and abnormal conditions to Manager are included in the duties. The Lead Hand must maintain a minimum Class I Water Distribution certificate to fulfill the required responsibilities.

The Lead Hand has authorization to take control of emergency situations (eg. water main break) and use whatever equipment is necessary to complete repairs in a safe and efficient manner.

9.8 Operator in Charge (OIC)

An OIC is selected for each shift for both the Water Treatment and the Distribution System. The OIC can be any operator that has a minimum Class I certificate for the Water Treatment and Distribution Systems. The OIC for each shift must be identified in the daily log books. The OIC for the Water Treatment Plant has responsibility and authority to make all data entries in the logbooks and on log sheets, performs all on-site water tests, and makes and records all process adjustments. The OIC for the Distribution System has responsibility and authority to assist oversee operators and contractors in the repair and maintenance of all aspects of the distribution system, and in responding to emergencies.

9.9 Operator

All operators are responsible for maintaining required Ministry of the Environment Certification for the Water Treatment and Water Distribution Systems. Operators are required to carry out the daily duties for the treatment and distribution processes to ensure operations are completed and recorded in compliance with O. Reg. 170/03 and O. Reg. 128/04. If non-compliant incidents occur, they must be acted upon, reported and recorded as required by O. Reg. 170/03 and O. Reg. 128/04.

Certified operators are authorized to collect samples, perform testing, adjust treatment processes (with direction from the Chief Operator), and perform maintenance on the treatment and distribution systems, in accordance with standard operating procedures, to ensure a safe and adequate water supply.

10. Competencies

As of November 22, 2005 the Ministry of the Environment reclassified the City of Dalkeith Water Supply System to a Class II Treatment and Class I Distribution system.

10.1 Identifying Competencies

The following identifies the competencies required of City of Dalkeith staff whose performance may have a direct impact on drinking water quality.

10.2 Director of Engineering and Public works

Shall possess advanced theoretical and working knowledge of administrative skills expected of a senior level manager. In addition an intermediate theoretical and working knowledge of the Safe Drinking Water Act and applicable regulations, and the City of Dalkeith Drinking Water Supply System.

10.3 Manager, Infrastructure and Works

Shall possess advanced theoretical and working knowledge of administrative skills that are expected of a mid level manager. Shall possess advanced and intermediate theoretical and working knowledge of the Safe Drinking Water Act and applicable regulations, and the City of Dalkeith water supply system.

10.4 Operator Competencies

Ontario Regulation 128/04 requires that all Water Treatment and Distribution operators possess operating licenses appropriate to the class of facility where they are employed.

The Overall Responsible Operator (ORO) shall have a minimum Class II Water Treatment certificate or Class I Distribution certificate, as applicable.

Operators acting in relief of the ORO shall have a minimum Class II Water Treatment certificate or Class I Distribution certificate, as applicable.

All operators shall have at least an OIT level certificate, while ultimately working toward obtaining a Class II Water Treatment or Class I Distribution certificate.

Operators are required to have skills and knowledge in the following areas:

10.5 Treatment Plant Operator

- An understanding of the concepts of water borne diseases, pathogens and other bacteria related to water and the reasons for water treatment and disinfection. A basic knowledge of math, science and chemistry used in the treatment process is required.
- An understanding of the water treatment process, including chemically assisted filtration and the CT concept, to ensure proper disinfection.
- Knowledge of water regulations and identifying, reporting, and responding to adverse drinking water conditions as required by regulations
- An understanding of the importance of following policies and procedures, and the potential consequences for not following them
- Performing lab analyses and interpreting results
- Working knowledge of the operation of the water treatment system using the SCADA (Supervisory Control and Date Acquisition) system
- Working knowledge of the operation of the water treatment system without the SCADA system
- An ability to handle emergency situations
- Adjusting and checking chemical feed rates
- Safe practices for handling chlorine and for maintaining and repairing the chlorinators
- Conducting filter maintenance and backwashing
- Conducting pump maintenance and repair
- Knowledge of the chemicals used in the water treatment process, and safe handling practices

10.6 Distribution System Operator

- Familiarity with the City's water distribution system
- An understanding of secondary disinfection
- Knowledge of water regulations and identifying, reporting, and responding to adverse drinking water conditions as required by regulations
- Repairing leaks safely and follow regulatory requirements for disinfection of new and repaired watermains

- Conducing valve maintenance and repair
- Conducting hydrant maintenance and repair

10.7 Satisfying Competencies

The following satisfies the competency requirements for City of Dalkeith staff:

10.8 Management

- Top Management is briefed on operating conditions and is provided updates required by regulations at regular meetings with mid level management.
- Management regularly attends relevant drinking water training courses, conferences, and seminars.

10.9 Operator Training & Certification

New Operators (OIT's)

After successful completion of the OIT Water Treatment and Water Distribution Prep Course (60 hrs) and OIT exam, a new operator will train with an experienced operator until a satisfactory level of competence has been reached. The Manager of Infrastructure and Works and applicable ORO will determine when a satisfactory level of competence has been reached, through observation and peer review.

Class I Water Treatment & Distribution Operators

After the level of competence has been reached, (usually about one year), the operator must successfully complete the Class I Water Treatment & Water Distribution Prep Course and Class I exam to become a Class I Water Treatment or Distribution operator.

Class II Water Treatment & Distribution Operators

After working approximately one year at the Class I level, the operator can advance to a Class II Water Treatment or Distribution operator by successfully completing the Class II Water

Treatment & Distribution Prep Course and Class II exam for either Water Treatment or Distribution.

Class III & IV Treatment and Distribution Operators

Although the treatment plant and distribution system are a Class II and I, respectively, all operators are encouraged to advance to the highest level of classification that they wish to achieve. The employer recognizes that the extra training and skills are invaluable to the operation and this is recognized in compensation.

As part of the licensing requirement, all operators experience extensive on the job training. Specific requirements are listed in O. Reg. 128/04. According to the regulation, a Class II system operator requires 23 hrs of on the job practical training and 12 hrs of formal CEU training per year. A Class I operator requires 23 of on the job practical training and 7 hrs of formal CEU training per year.

Other than the prep courses noted above, some of the other training courses attended by operators are:

- Gas Chlorination Workshop
- Hypo Chlorination – Disinfection Workshop
- Water Main Disinfection Workshop
- Water Treatment Proficiency course
- Filter Operation and Maintenance course
- Pump Maintenance & Repair
- Hydrant Maintenance & Repair
- Confined Space Workshop
- WHIMIS

All courses and training attended by operators are documented and signed by the employee and trainer, which acknowledge successful information transfer. Training files are maintained for all City of Dalkeith operators at the Public Works office.

10.10 Recruitment Planning

The City of Dalkeith water department also operates the wastewater treatment and collection system. Operators work at both treatment plants on a scheduled rotation. Operators require experience, training and certification in both fields. This has to be taken into consideration when planning personnel recruitment. Starting as an OIT, it may take approximately 5 years to fully certify a Class II operator for both plants.

Presently we have five treatment operators on staff; this includes the Chief Operator and two operators at each plant. This currently meets staffing requirements at the plants. The distribution system is similar in that operators require experience, training and certification in distribution and collection. Presently there are two full time operators and one seasonal operator.

11. Personnel Coverage

11.1 Water Treatment Plant

The water treatment plant operators work daily from 07:30 until 15:30. There are two operators on duty at all times, with the exception of vacation, days off, etc.

The #1 Operator (OIC) looks after the daily process operations like raw and treated water testing, flow totals, pump logs, filter backwashing and chemical totals, and makes all entries on daily log sheets and in the plant diary.

The #2 Operator assists in equipment maintenance and repair, and assumes the duties of the #1 Operator in his absence.

The Chief Operator (ORO) oversees the day-to-day operation of the Water Treatment Plant and designates the OIC.

The plant is equipped with alarms on all plant process equipment, pumps and chemicals. Alarms are monitored by the SCADA system, which transfers alarms to the police dispatcher via telephone lines, who in turn contacts the operator on call. Alarms to the dispatcher are not specific, they are all Water Plant alarms, and so the operator must respond immediately to the

plant. Although an exact response time is not specified, a time of 5 – 15 minutes is the normal response time.

In the event of an emergency, all operators report to the water plant immediately and wait for instructions from the ORO.

Operators are on call daily from 15:30 → 07:30, seven days a week from Monday to Monday. All operators are on a scheduled rotation. The operator on call also works the weekend and is the back up ORO.

11.2 Distribution System

The distribution operators work Monday to Friday, 07:30 → 16:00. After hour emergency calls are taken by the water plant on call operator, who assesses the problem and calls out the appropriate personnel.

11.3 Strikes and/or Lockouts

At this time there is no plan in place for personnel coverage during a strike or lockout.

12. Communications

12.1 City of Dalkeith – Owner / Operating Authority

The Director of Engineering and Public works will provide twice-yearly updates on the QMS at public Council meetings. All proposed revisions would be communicated by the Director before seeking Council's authorization. The Mayor, Council and City Manager will be provided with a current copy of the QMS immediately following any revision.

12.2 City Personnel

Copies of the currently approved QMS Operational Plan will be kept at the Water Treatment Plant and at the Public Works offices. Communication to staff will be handled internally through informal meetings and feedback from operators. Regular Public Works manager meetings will be used to keep supervisory staff informed.

12.3 Suppliers

The Dalkeith Water Treatment Plant achieves oversight control over the activities of all suppliers and service providers through annual written communications and formal agreements.

The written communications inform each supplier / service provider of policies and regulations with which the city must comply. The communication also provides a list of all documentation that is required, such as ANSI / NSF certification, MSDS's and proof of laboratory accreditation for the samples being analyzed.

Suppliers and delivery personnel must report to the operator prior to delivery of the product.

This document can be found at the PW office, in the WTP Chemicals file.

12.4 Consumers

Copies of the QMS will be available for viewing at City Hall and at the Public Works offices. The Director will communicate updates and revisions of the QMS at an open public Council meeting. Questions can be directed to the Manager, Infrastructure and Works.

In addition, Annual Water Treatment Plant reports, required by O. Reg. 170/03, are available to consumers in hard copy at the Public Works office and can also be viewed on the City of Dalkeith website. The public is made aware of the Annual Water Treatment Plant report and QMS through notices provided with the water bills.

Consumer water complaints can be handled through the Public Works Office or through the Water Treatment personnel. Refer to Section X I, page 5, in the WTP Operations Manual for Procedure for handling water related complaints.

13. Essential Supplies and Services

Below is a list of all supplies and services deemed essential for the production and delivery of safe water. All chemical supplies must meet ANSI and NSF standards. Appropriate paperwork must be provided upon chemical delivery to confirm the product being delivered. All laboratories must be accredited to test the parameters for all samples that are submitted to them.

Alternate suppliers / services providers are noted below to ensure that the supplies / services are available as needed.

Chlorine	**Brenntag Canada Inc.**
	1234 Main Street, Lake Louise, ON
	555-894-2356
Alternate:	**Cleartech**
	785 John Street, Lake Louise, ON
	555-845-1586
Aluminum Sulphate	**Eaglebrook Inc,**
	3405 Blvd. Marie Victorin, QC
	555-789-4531
Alternate:	**Chemicals R Us**
	485 Main Street, Lake Louise, ON
	555-597-8623
Lime	**Brenntag Canada Inc.**
	1234 Main Street, Lake Louise, ON
	555-894-2356
Alternate:	**Chemicals R Us**
	485 Main Street, Lake Louise, ON
	555-597-8623
Nalclear 8181	**Nedco Canada Co.**
	1055 Davis Street, Burlington, ON
	555-879-8451
Accredited Laboratory Services	**Maxxam**
	222 York Street, Dufferin, ON
	555-789-7892
Alternate:	**MSG Bayfield**
	485 Main Street, Lake Louise, ON
	555-597-8623
Chlorinator and	**Metcon Sales & Engineering**
Lime, Alum & 8181 parts	**486 Cherry Street, Toronto**
	555-486-4862
Alternate:	**SPD Sales Ltd**
	84 Main Street, Lake Louise, ON
	555-486-1859
Pump parts	**Metcon Sales & Engineering**
	83 Main Street, Lake Louise, ON

	555-486-7832
	Alternate: MSG Bayfield
	2 Main Street, Lake Louise, ON
	555-486-7186
SCADA & Instrumentation	**Honeywell (Jim Williams)**
	2 St. John Street, Mississauga
	555-486-7489 Cell 555-489-7712
Hydro One	**1 – 800 – 486 – 4863**
L & M Vacuum Truck	**223 – 3298**
Jim's Vacuum Truck	**486 – 4896 or 486-5894**
Joe's Excavations	**486-4843**
Mark Peters (backhoe services)	**483 – 8459**

14. Review and Provision of Infrastructure (covered under Section 15)

15. Infrastructure Maintenance, Rehabilitation and Renewal

The City of Dalkeith has implemented a preventative maintenance program for the water supply system. Preventative maintenance schedules and procedures for the Water Treatment Plant are described in the Operations Manual. Preventative maintenance on the distribution system is performed on a regular schedule that is reviewed and updated by the Manager, Infrastructure and Works, according to needs and priorities. The schedule is posted at the public works building in the water distribution shop.

Equipment and pumps at the WTP are regularly serviced and documented records are kept at the WTP in the equipment maintenance binder. Details of these procedures can be found in the WTP operations manual. Distribution system maintenance consists of flushing of hydrants in May and June. When hydrants are flushed, isolation valves are occasionally checked along with hydrant markers and visible identification numbers. This information is documented on hydrant inspection forms, which are located in a binder at the public works building in the water distribution shop. When hydrant flushing is complete, a valve-exercising program is started. This consists of physically operating main line valves and documenting information such as the date, locations and problems found on valve inspection sheets located in a binder in the water distribution shop. This program is in the initial stages and is not yet fully implemented.

Rehabilitation and renewal of the water supply system is performed on a needs schedule. Capital and operational money is allocated each year for improvements to the system. The Director of Engineering and the Manager, Infrastructure and Works determine the areas that the money will be spent in consultation with operators and upon reviewing the Land Use Implementation and Servicing Plan Study. The Servicing Plan Study details areas that the City should look upon to improve and rehabilitate in the existing system, on a prioritized schedule. The schedule was determined after an extensive review by Earth Tech Consulting Engineers. Once priority projects are determined, City staff or consultants complete detailed estimates to establish how much capital will be required to complete the project. The capital requirements are then submitted to senior management and council for budgetary approval.

In addition to the schedule from the Servicing Plan Study, staff suggestions, consumer complaints, and water quality trends are taken into consideration when the schedule is reviewed for rehabilitation and renewal work needed. In addition, these are all also taken into account to assess if the infrastructure necessary to operate and maintain the water supply system is adequate.

A report detailing the maintenance programs, any requirements for infrastructure and for rehabilitation and renewal of the infrastructure is prepared annually by the Director of Engineering and Public Works, following the Management Review. The report is provided to council a the next council meeting.

16. Sampling, Testing and Monitoring

The Dalkeith Water Treatment Plant has a sampling program based on the requirements set out in O. Reg. 170/03 and our current Certificate of Approval. This sampling plan and schedule is documented in the **Water Treatment Plant Operations Manual**.

A competent certified operator performs all in house sampling. Results are recorded on a daily log sheet and monitored by plant operators. Detailed procedures for all tests performed on-site are provided in the Operations Manual. There is also a section in the manual devoted to identifying and responding to adverse sample conditions.

Distribution chlorine residuals are checked daily at the wastewater treatment plant (WWTP), and weekly at the six bacteriological sample sites by a plant operator. Results from the daily tests are recorded on the log sheet at the WWTP. Results from the weekly chlorine tests are recorded on the laboratory chain of custody forms, and copies are filed at the WTP.

In addition to the tests conducted by operators, bacteriological and chemical tests are collected by plant operators and submitted to an accredited laboratory for testing, as required by Ontario Regulation 170/03. Test results from the accredited lab are e-mailed to the water plant where they are filed electronically on the server. A hardcopy is sent to the Public Works office and is filed on site.

Copies of all test results are provided to members of the public upon request. Furthermore, all results are summarized in tables at the end of the year and are discussed in the water plant annual compliance report. This report is provided to council at the next council meeting, and is also available to the public via the city website or in hardcopy form.

17. Measurement and Recording Equipment Calibration and Maintenance

17.1 On-Line Measurement

At present our on-line measurement devices consist of, filter effluent turbidity meters, a treated water turbidity meter, a treated water free chlorine residual analyzer, and raw and treated water temperature probes.

Turbidity and chlorine analyzers are calibrated according to recommendations in the manufacturers' operation manuals and documented in the daily logbook and quarterly duty log. All on-site bench-top analyzers are sent to the manufacturers' for recalibration as per the manufacturers' recommendations.

Detailed procedures for calibrating each device are in the plant Operations Manual.

The results from the calibrations performed on each device are displayed and recorded on the SCADA system.

18. Emergency Management

Detailed documented procedures for emergency situations, which could result in adverse water quality in the drinking water supply system, are located in the **Water Treatment Plant Operations Manual.** Detailed documents for procedures to respond to adverse water quality and reporting procedures are located in the **Water Treatment Plant Operations Manual**. Detailed procedures for responding to other emergencies are documented in the **Water Treatment Plant Emergency / Contingency Plans** manual. The manuals are located at the City of Dalkeith Public Works offices and at the City of Dalkeith Water Treatment Plant. These procedures outline the roles and responsibilities of the owner and the operating authority for the emergency conditions.

18.1 Preparedness

All operators in the City of Dalkeith have training and are aware of the locations of written procedures to deal with emergencies in the water treatment and distribution system. The emergency situations and response and recovery procedures will be reviewed at monthly safety meetings for refreshment. Once a year, a desktop exercise would be conducted to test selected emergency procedures. If present methods should change, or if new employees are brought into the system, semi- annual training would occur on dealing with emergency situations. Senior employees or direct supervisors would provide this training. All training would be documented and placed into employee personnel files.

Twenty-four hour on call operators and Water Treatment Plant alarms ensure that a qualified staff member will attend and assess any emergency situation within a very short period of time. The **Emergency / Contingency Plans** manual contains an up to date list of emergency contacts. A list of staff contact numbers is provided below and in the **Emergency / Contingency Plans** manual.

18.2 Water Emergencies

During working hours of 8:00 am to 4:00 pm, calls will be received at the **Public Works Office – 653-8956** or the **Water Treatment Plant – 653-5423.**

After hours and weekends, refer to the weekly call out list located at the Public Works Offices or call Police dispatch at **653-1287.** Police dispatch will have a current call out list for the Water Treatment Plant.

18.3 Water Service Problems

If a customer calls with “no water” or “low water pressure” the operator shall be dispatched to confirm the water mains are functioning properly and there are no water main breaks. If the problem is not in the watermains, then the customer will be told to call a plumber. If a customer calls with a water quality problem, such as odour or bad taste, a water treatment plant operator will be dispatched to assess the problem.

Water Treatment Plant Emergency Contact List

Bob James	Chief Plant Operator	Ph: 653-8924
Lewis Smith	Operator	Ph: 653-2654
Sandra Dickson	Operator	Ph: 653-4785
Hugh Donaldson	Operator	Ph: 653-2596
George White	Operator	Ph: 653-1489

After hours problems at the water plant will be indicated by alarms, which will be attended to by the on call operator.

Distribution System Emergency Contact List

Duane Younge	Waterworks Lead hand	Ph: 653-5632
Waterworks Maintenance Person	Waterworks Operator	
Operations Lead hand		Ph: Refer to call out list
Roy Williams	Manager, Infrastructure and Works	Ph 653-5814
Blane Harvey	Operations Manager	Ph 653-8369
Bob James	Chief Plant Operator	Ph 653-5687
Doug Patterson	Operations Lead hand	Ph 653-2345
Operations On-Call		Cell 653-8536

Operations Night shift	Cell 653-2596

19. Internal Audits

The City of Dalkeith has documented a procedure for internal audits. The procedure is titled QMS Internal Audit and is included in Appendix B of this Operational Plan.

20. Management Review

The City of Dalkeith has documented a procedure for Management Review. The procedure is titled QMS Management Review and is included in Appendix C of this Operational Plan.

21. Continual Improvement

The City of Dalkeith will establish and maintain a Drinking Water Quality Management System that will be regularly reviewed, improved and upgraded by management and employees involved in the supply of drinking water.

When appropriate, the City of Dalkeith will modify/update adjust processes and procedures (while remaining in compliance with MOE regulations) to improve operations and customer satisfaction.

APPENDIX A

DOCUMENT AND RECORD CONTROL PROCEDURE

1.0 Procedure Description

This procedure defines the processes in place to ensure control of all documentation and records affecting the City of Dalkeith QMS. This is necessary to ensure that creating, revising, approving and releasing documents are completed in a consistent manner to make certain they are retrievable, current and accurate.

2.0 Reason for Procedure:

To ensure control of documentation and records which affect the City of Dalkeith QMS.

3.0 Responsibility:

The designated QMS Representative, (or the alternate), shall be responsible for the control of all QMS documents. All documents must meet the approval of the QMS Representative before the initial issuance or the issuance of a revision. The presence of a signature in the QMS header on the document indicates this approval.

4.0 Procedure:

The following is a list of key documents and records that are relevant to the QMS, and the locations in which they can be found.

List of Key Documents and Records	
Document / Record	**Location**
Water Treatment Plant Certificate of Approval	Public Works Office File
WTP System Classification	WTP / Public Works Office File
Water Distribution System Classification	Public Works Office File
QMS Operational Plan	WTP / Water Manager Office
Land Use Implementation and Servicing Plan Study	Public Works Library
Maintenance Manuals	WTP / WD Office
WTP Building and Site plans	WTP
Operator Certifications and Training Records	PW office / WTP
Supplier List & Documentation	WTP/ PW Office
Treatment Operators Log Book	WTP
Distribution Operators Log Book	PW Office

Calibration Manuals and Records	WTP
Equipment Maintenance Records	WTP
Operational records	WTP / Shared Drive
Lab Results	Shared Drive, Hardcopy at PW Office

All QMS documents are equipped with a header and footer which include the title of the document, the date, the QMS Representative signature and a statement indicating that it is an uncontrolled printed copy. A revision table is provided at the beginning of the QMS Operational Plan to track changes to the QMS.

All original documents and records for the Water Treatment Plant and Water Distribution System are kept at the Public Works Offices central computer and in hard copy. Duplicate operational documents and records are located at the Water Treatment Plant. The electronic version of each internal document is password protected to restrict access to the QMS Representatives. The currency of internal documents is ensured by comparison of the date in the document footer to that of the central computer system or the original or duplicate stored at the Public Works Offices and Water Treatment Plant.

The filing system at the Public Works Office is organized into numbered and titled documents filed into annual or on-going project files. If possible, new files are duplicated electronically and stored on the shared network drive, which is backed up automatically each night. All documentation / records related to water supply, including operator training and certifications, are added to existing files that are readily identifiable and retrievable in a designated storage cabinet in the Public Works file room. Some older records that are not relevant in day-to-day operations may be filed in a separate room on the second floor of the Public Works building, where they are still easily accessible. All documents and records are retained and filed. No documents or records are disposed of.

Water Treatment Plant (WTP) SCADA data is stored electronically in duplicate, with one set saved on the shared network. The shared network is automatically backed up each night. Daily logbooks for the WTP and sampling records are filed at the WTP. Daily logs for the Water Distribution System are stored at the Water Department office at the Public Works building.

APPENDIX B

INTERNAL AUDIT PROCEDURE

1.0 Procedure Description

This procedure defines the process used by The City of Dalkeith to conduct internal audits of the Drinking Water Quality Management System (QMS).

2.0 Reason for Procedure

Internal audits are conducted to confirm that the QMS is effectively implemented and meets or exceeds the requirements of the Standard.

3.0 Responsibility

Internal audits shall only be conducted by persons approved by the QMS Representative and having the following qualifications:

- Employees who have completed internal audit training.
- Employees of other operating authorities who have completed internal audit training and who have completed a minimum of two internal audits of quality management systems within their own organizations.

4.0 Procedure

- This procedure is applicable to City of Dalkeith management, plant operations, and distribution activities that fall under the scope of the QMS.
- \Internal audits are conducted at least once every twelve months and at least 60 days prior to the Management Review.
- Internal auditors will be selected by the QMS Representative.
- Internal auditors shall review the Standard and previous internal and third-party audit reports in preparation for the audit.

- The audit checklist created and maintained by the QMS Representative shall be used by the internal auditor as a guideline for conducting the interviews and document review during the audit.
- The audit report shall be in the form of a completed audit checklist.
- The audit report shall include a description of any non-conformances between the QMS and the Standard, including a reference to the section of the Standard.
- The QMS Representative shall issue Corrective Action Requests (CARs) to the appropriate personnel to address the non-conformances with the Standard. Responses to CARs shall be provided to the QMS Representative within 30 days and may include resolution of the non-conformance or action plans with set timelines for resolution.
- The internal audit shall be considered closed upon submission of the audit report to the Management Review Committee.

5.0 Associated Documents

- *Management Review Procedure*
- *Internal Audit Checklist*
- *Internal Audit Schedule*
- *Drinking Water Quality Management Standard*

APPENDIX C

MANAGEMENT REVIEW PROCEDURE

1.0 Procedure Description

This procedure defines the process for the review of the effectiveness of the Drinking Water Quality Management System (QMS) by the Management Review Committee.

2.0 Reason for Procedure

Management reviews are conducted to assess and ensure the continuing suitability, adequacy, and effectiveness of the QMS.

3.0 Responsibility

Management reviews shall be conducted during a meeting of the following participants:

The City Manager (Top Management)
The Director of Engineering and Public Works (Top Management)
The Manager, Infrastructure and Works (QMS Representative)
The Chief Plant Operator (QMS Representative)
Other participants may be added at the discretion of the Management Review Committee. The meeting is chaired by QMS Representative or Alternate.

4.0 Procedure

- This procedure is applicable to The City of Dalkeith management, plant operations, and distribution activities that fall under the scope of the QMS.
- A management review shall be conducted at least once every twelve months, following completion and documentation of an internal audit and prior to the next scheduled third-party audit.
- Prior to the Management Review Meeting, the QMS Representative or Alternate shall provide a meeting agenda and summaries of the following information to the Management Review Committee:

  - Listing of incidents of regulatory non-compliance
  - Incidents of adverse drinking water tests
  - Deviations from critical control limits and response actions
  - The efficacy of the risk assessment process
  - Results of any relevant internal and third-party audits
  - Results of emergency response testing
  - Summary / trending of operational performance (raw and treated) noting any deficiencies
  - Status of action-items from last Management Review
  - Status of management action items identified between reviews
  - Changes that could affect the QMS
  - Consumer feedback / complaints
  - Resources need to maintain the QMS
  - The results of the infrastructure review
  - A review of Operational Plan currency, content and updates
  - Summary of Commission Meeting minutes pertaining to the QMS scope
  - Changes in process or management that may affect drinking water quality
  - Recommendations for improvement of the QMS
  - Results of regulatory compliance inspections

- The Management Review Committee shall review and discuss all information presented. The Committee shall make recommendations and initiate an action plan, including the person responsible for delivering the action items and the proposed timelines, to improve the content and implementation of the Operational Plan and related procedures, and to ensure the provision of adequate resources.
- Minutes of management review meetings shall be maintained by a QMS Representative or Alternate. The minutes shall document all new and outstanding action items as well as any decisions made by the Committee.
- The QMS Representatives or Alternate shall be responsible for communication and implementation of the management review action items as per item QMS Communication procedure.
- The QMS Representative will provide a copy of the minutes of the Management Review meeting to council during the next council meeting.

5.0 Associated Documents

- *Internal Audit Procedure*
- *Drinking Water Quality Management Standard*